SCIENCE AND CULTURE

A Monthly Journal of Natural and Cultural Sciences

Vol. 14 JULY 1948 No 1

OBJECTIVE THINKING, AND OPERATIONAL RESEARCH

IN our two articles on the Problems of Independent India, we have drawn attention to the need for all-India view of problems, and of necessity for thorough going reforms in the administrative machinery of the country The present article will deal with the need for objective thinking, and suitability of introducing methods of operational research to deal with problems confronting the country

The disappearance of British rule has left us with old unsolved problems, like those of poverty, hunger and disease, low productivity in industry and agriculture, all due to the continuation of paleotechnic methods, and emergence of new problems like those of extreme provincialism, and the threat of babelism, both of which may ultimately lead to the disintegration of India , and growth of spirit of intolerance, and indiscipline amongst the masses Some of the problems *e g* provincialism and babelism are the creations of our present day leaders, who made use of them to discredit British Imperialism but are now unable to cope with the monster raised by them , others also in an indirect way, because corruption, indiscipline and tendency to have recourse to violent methods on the slightest provocation, are to some extent the result of suffering caused by rise in prices, widespread black marketeering, and fall in production, which the Government has not found possible to control

The methods adopted by those in power to meet situation shows little grasp of facts and a tendency to rush from one hasty generalisation to another For example, when supply of cloth or other commodities become tight, there are talks of control, or nationalisation of the industries Now '*Nationalisation*' means taking over the Industry by the Government and running it by its own officers But whilst capitalists may not be a lovable lot, and nationalisation may ultimately prove a blessing, have those who raise the cry of Nationalisation to cover their own failure to meet a problem, ever given thought to the fact that even industries and activities which are at present completely nationalised, are not running efficiently Take rail-road communication, telephone service in our big cities, or the armament industries which are all completely nationalised These services were very efficient before the war, why have they now become byewords for inefficiency? The problems of bringing back these services to their pre-war standard of efficiency are all known, and can be tackled swiftly and efficiently by a determined Government It is up to Government representatives to explain to the public what steps they are taking and when they expect to bring the services back to their pre-war standard of efficiency

No problem can be solved if those in power still persist in passing from one slogan to another, and thus rousing the people to mass-hysteria to cover their own inefficiency All problems must be studied in an objective way and operations to be taken should be decided after objective study of facts and figures, and a careful consideration of the consequences to which these operations may lead This requires widespread use of a method which has received the name of 'Operational Research' in course of the last War

There have been various definitions of the term 'Operational Research', and one of the best is due to Kittel '*Operational Research is a scientific method of providing executive departments with a quantitative basis for decisions regarding the operations under their control*' !

The method of operational research was evolved during World War II, by bands of scientists used to objective thinking in the laboratories, when not

fronted by such problems as defending Britain against air-invasion or submarine menace Methods of operation of the available fighting material were evolved by teams of scientists from actual objective study of effects of air attack on U-boats, or use of radar and fighting aircraft against bombers The air or coastal command had thus to be guided in their decisions by teams of scientists The psychological effect of the intrusion of scientists in the matters of tactics on the mind of the military command was sometimes not very happy In fact, a senior Bomber Command Officer enquired indignantly whether the war was to be fought with slide rules or the weapons But thanks to the support by the Prime Minister, the slide rule was preferred and won !

There is a consensus of opinion amongst scientists who have evolved the operational method in war that it can also be applied to peace time problems In course of a discussion, Prof J D Bernal says (*Nature*, November 31, 1947)

"The same needs, he contended, that led to the appearance of operational research in war should now lead to the conversion of that experience to peaceful uses, since the gap between imports and exports and the impossibility of Britain feeding itself are at least as serious and immediate as any war situation 'Operation Production' should be considered with the same urgency and common purpose as 'Operation Overlord' The technique of operational research could be made available to find out what has to be done, to check the success of the operation and modify its conduct It is essential that the country's very limited resources in trained man-power in engineering and science should be used in the most effective way with a scientifically determined system of priorities, weighing not only present resources, but also those which could be increased, often by very large factors, by the application of high-pressure research and development Only a combination of economists, engineers and scientists could achieve this , but they must operate on the highest planning authority in the country The most obvious priorities are coal, steel, building and agriculture but others such as transport, distribution and the utilization of chemical wastes may prove equally important Prof Blackett's general principle of operational research should be used, to do those things which combine the greatest need with the most rapid possibility of achievement

All these are in the nature of economic planning, but physical research is required wherever materials and techniques have to be transferred from their present use to some new one Lively and effective research would also be necessary on the workshop and farm level, and all the ingenuity in the country would be needed to solve the thousand small problems that would arise Thousands of scientific workers and engineers are being used in a wasteful manner or for purposes of secondary importance—a very large number in industry and probably as many in Service research Operational research is needed to find the best distribution and to check redistribution It would be tragic, he concluded, if this one organisational development of the War were not given the chance to show its capacity in the peace "

We believe that the use of 'Operational Research Methods' to peace time problems, advocated by Prof Bernal for Britain is applicable to almost every country, particularly to India But here we are faced with a very serious problem—first the dearth of a sufficient number of men trained in the methods of scientific research and objective thinking, secondly lack of support of recommended measures by those in power

It is only the universities and higher research institutions which can provide us with men capable of objective thinking and undertaking operational research to help the executive But the British bureaucrats who were in power till a year ago, did not encourage higher university education or growth of research institutions The new Government have not yet taken any decisive steps for the amelioration of this state of affairs The percentage of provincial budget spent on education still ranges from 5 to 18 per cent, and the educational expenses of the Central Government still continues to be less than 1 per cent of the total budget ! Contrast this sad neglect of University education in India with conditions in China where, according to a clause in the constitution, 15 per cent of the central budget must be spent on education

POLITICIANS *VS.* SCIENTISTS IN THE U

[*We reproduce the two following communications from the* NUCLEONICS, *and the* SCIENCE NEWS LETTER, *which describe vividly the present difficulties under which scientists have to work in the U S A It appears that secrecy regulations, introduced to retain the secret of the Atom-Bomb, is vitiating the scientific atmosphere Prof E U Condon, who figures chiefly in these communications is a physicist of international reputation, author of the 'Frank-Condon Principle', joint author of the theory of* α*-ray disintegration and is at present director of the Bureau of Standards, Washington, D C —Ed* SCIENCE AND CULTURE]

CONDON ASKS INVESTIGATION BY SENATE-HOUSE COMMITTEE

ON March 4th, Dr Edward U Condon, director of the National Bureau of Standards, sent the letter below to Senator Bourke B Hickenlooper, chairman of the Senate-House Committee on Atomic Energy This letter was written as an appeal for an investigation of the "problem of proper relations of the Government to scientific personnel" It was requested that this investigation be apart from that being conducted by the Committee on Un-American Activities, the committee which directed charges of "disloyalty" against Dr Condon last month

The following is the text of the letter

"As you know, the House Un-American Activities Committee has released a report making insinuations about my loyalty and charges of untrustworthiness as a scientist in the Government service I am not concerned about these charges as they affect me personally These same accusations were made in a newspaper story and in magazine articles written by Congress man Thomas (J Parnell Thomas, Republican, New Jersey) in June of 1947 Before that time and since then I, like other Government scientists, have been investigated and re-investigated by various agencies of the Government and, so far as I know, have been uniformly cleared In fact, in July 1947, after Congress man Thomas' articles appeared, I wrote Congress man Thomas and the members of his committee offering to appear before the committee and to help in any way to answer any questions that they might have concerning me I received no answer

"That, however, is not the issue that concerns me As in the case of many other scientists, Government service is not for me merely a means of making a livelihood It is an opportunity to serve my country and its scientific advance

"What concerns me is the national weakness and disintegration of our scientific position, if this whole question of proper relations between working scientists and their Government is not fully clarified It seems to me that this should be done at once Because of the very special position which atomic energy has in matters of scientific research, I therefore respectfully suggest that your committee give this matter a complete hearing and careful study I have been trying since I came to the Government to develop and improve the staff of our principal Federal agency, the National Bureau of Standards, for fundamental research in physics, chemistry, mathematics and engineering The work of the bureau in the field of atomic energy is limited, but important, and the vital character of atomic research to our national security and well-being is such that no part of it can be endangered or imperilled for any cause without great damage to the country

"Frankly, recruiting and keeping scientists in the Government service is not an easy job at best, because of salary limitations, budget difficulties and the notorious amount of administrative detail with which the Federal Government burdens its scientists But in addition to that there has been a mounting tension of threats, of purges, spy-ring exposures, publicity attacks and sudden dismissals without hearings

"All of these make scientists increasingly reluctant to work for the Government They greatly unsettle their minds, and distract them from the creative efforts which we hope to get from them Because of these conditions it is becoming increasingly difficult to ask a man to accept a position with any scientific agency of the Government

"This is a matter of concern to your committee because such conditions also apply to the operations directed by the Atomic Energy Commission Only last week a prominent physicist from the laboratories at Oak Ridge came to see me, and told me that a group of them were going to leave and wanted to come to work for the Bureau of Standards I could give them no assurances that conditions of work in the Bureau of Standards would be any better than the conditions at Oak Ridge as they were described to me While this person seemed sceptical at the time I am sure he is this week convinced of the truth of what I said

"An honest reading of the history of the war will show that Germany, Italy and Japan greatly weakened their scientific condition by a series of purges of prominent scientists and a general intimidation and stifling of the spirit of free inquiry among the others *It has been said that after every war the*

victors adopt the vices of the vanquished I am sincerely concerned that we are on the point of doing that in the matter of how we deal with scientists in Government

"The issue is larger than appears on the surface because with the growing inter-relationship of science and government there are today very few working scientists (at least in the physical sciences) who are doing work for the Government or associated with institutions deeply involved in this kind of work Therefore the whole scientific life of the nation is involved

"I am convinced that your committee, with its established record of careful thorough study of the problems before it, could do the country a great service by studying the whole problem of proper relations of the Government to scientific personnel Your committee has justly earned the confidence of the nation's scientists, as well as the general public, by reason of its demonstrated understanding of the nature and importance of the scientists' work I would hope that an investigation by your committee would result in restoring conditions in which men of intelligence will be willing to work for their government and will not be constantly harassed and harried by irresponsible attacks on their character It must be remembered that the physicists of this country instituted voluntary security measures in 1939 long before they were able to get their Government to show an interest in atomic energy matters

"In fairness and justice we must put an end to public smears on scientists in and out of Government, and we must also do it in order not to throttle the scientific research which is so important to the material side of our civilization

"If your committee should undertake to make this study I assure you that I will be glad to co-operate in every way, and I am confident that scientists and scientific organizations throughout the nation will provide you with every assistance you may desire "—(*Nucleonics*, April, 1948)

Dr Condon is Defended

Requesting that distinguished scientists be permitted to testify and that Dr Edward U Condon, director of the National Bureau of Standards, be given an opportunity to cross-examine witnesses, attorneys for Dr Condon have sent a letter to the House Committee of Un-American Activities regarding the hearing scheduled by the Committee for April 21

The letter from the attorneys, the firm of Arnold, Fortas and Porter, was signed by the three partners Thurman Arnold, former assistant U S Attorney General , Abe Fortas, former Under Secretary of the Interior , and Paul Porter, former administrator of the Office of Price Administration They declared in part

"The effect of the publication of your accusations against Dr Condon, and of the inflammatory and reckless manner in which that was done, may be devastating to the national interest There is abundant evidence that it has impaired the security and peace of mind of practically all of the leading scientists who are now employed on atomic bomb, radar, and related projects of fundamental importance to our security Your actions must inevitably cause scientists to hesitate to accept work in these fields , and they will doubtless tempt scientists now employed in these activities to seek other work of less national importance where their reputations will not be exposed to irresponsible attack, and their civil rights will be safe

"In fact, we respectfully suggest that the practices of your Committee may be retarding the scientific research which is the most vital part of our defence programme

"The number of scientists qualified for the exacting work required on many crucial projects is small The need for their services at this critical point in history is great Hitler drove out of Germany the very men qualified to discover the atomic bomb Among them were Albert Einstein, Leo Szilard, James Franck, Hans A Bethe, Otto Stern and others, who came to this country and made possible our development of the atomic bomb Mussolini drove Enrice Fermi out of Italy Dr Fermi is now one of our most distinguished atomic scientists The Communists persecuted George Gamow, and forced him to flee from the Soviet Union Dr Gamow is now one of our great nuclear physicists

"These men and many others, including outstanding native American scientists like Dr Condon, now have reason to wonder whether they will be allowed to work in this country, free from molestation

"Nothing can serve the ends of Communism to-day better than the intimidation of American scientific personnel through such tactics as your Committee has followed in the Condon case to date This Committee must avoid becoming an unconscious instrument of Communist purposes

"We therefore respectfully suggest that the Committee exercise extreme care in proceedings involving this country's critically important scientific programme and, further, that you avoid the possibility that your activities might aid and abet the very

forces you seek to combat—namely, Communism and the apparent effort of its agents to create disunity and confusion in this nation "

Enclosed with the letter to the Committee was a copy of an invitation letter sent out by Dr Harold C Urey, Nobelist in chemistry at the University of Chicago, as chairman of the Dinner to Edward U Condon Committee The dinner will be held "as a testimony of confidence by his scientific colleagues" in New York City, April 12 Sponsors of the dinner are more than 100 American leaders in various fields of science – (*Science News Letter*, April 10, 1948)

TIME AND CHANGE IN THE METAGALAXY

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HOW much of primeval chaos remains in the sidereal universe, and how much of order, is partly a question of definition We are inclined, for working purposes, to define stars and their attendant planets, comets, and meteors as orderly parts of the cosmos, and leave in the chaotic category the interstellar and intergalactic dust and gas, and the swirls of nebulous matter that are impelled through space by radiation pressure and other dissipative forces But this definition is quite artificial No true chaos exists for one who knows all the laws, and all the motions and masses of all material In the microcosmic world, the Heisenberg principle would suggest that no such knower could exist But we are speaking macrocosmically We are not yet blocked by unknowableness Our progress toward understanding the nature and the past and future history of the material universe will come through the formulation of partial laws, applying them to incompletely observed phenomena, and testing the predictions that evolve from the assumptions and analyses

The Time, here considered extends over a hundred million years , the Change cannot be directly observed It must be inferred from contemporary evidence on objects near and far, and therefore, thanks to the finite velocity of light, on objects old and young

Fortunately for our progress, there are observable changes in the stars and even in the galaxies We measure many kinds of variations , for example, the changes in position on the surface of the sky (very slight outside the solar system), and changes in motion, in light, surface temperature, and spectrum —but scarcely yet in age From these measures, however, we try to infer the ages of various sidereal bodies, and also the chemical composition, dynamical history, direction of evolution, and destiny The problems are large and our resources are small The examination of the ratio of recognized order to apparent chaos, and the relation of change to time, are fields of inquiry that are discouraging to those who would avoid philosophical speculation and would stay near the observables There seem to be too many vague puzzles But still, when we note how great was the progress in our understanding of the stellar universe during the past forty years, we see that continued observation, and theoretical attacks on the problems we know enough to formulate, will probably provide during the next generation the grounds for demonstrating how primitive our present concepts are

To help in making obsolete as many of our current views as possible, the Harvard Observatory has specialized in the study of the southern sky, which of necessity is somewhat neglected, because of the concentration of man-power and mind-power in the northern latitudes Harvard's large southern station in the Orange Free State, South Africa, is dedicated in considerable part to studies of the Metagalaxy—the over-all system of galactic systems But the several researches reported in the present communication on Time and Change in the Metagalaxy will deal both with problems that could not have been handled from the northern observatories and with others that require work in the North only The separate reports respectively concern

1 A description of major features of the Metagalaxy
2 Progress in the metagalactic survey at Harvard
3 An atlas of 78,000 galaxies north of Virgo
4 The galactic anti-center and its variable stars
5 Exploration of the Magellanic Clouds by means of variable stars
6 Distribution of luminosity in galaxies
7 Notes on the direction of development of galaxies

Introductory Concerning the Metagalaxy

Although the Metagalaxy was not in our science thirty years ago, we have now acquired a simply described picture of it In a vast but perhaps not limitless expanse of space and time we find that the common luminous units are galaxies, of which the principal constituents are stars The number of stars in a galaxy seems to be of the order of ten thousand million But there is a wide dispersion in population A supergiant galaxy, like our own Milky Way system, may contain more than two hundred thousand million stars, while some dwarf galaxies contain scarcely more than ten million Indeed, there may be sub dwarf galaxies, of still smaller population , and already there is convincing evidence that some of the external star clouds, that we would now call galaxies, are probably no more massive, or luminous, or populous than the greatest of the nearby globular star clusters Thus the bright globular cluster, 47 Tucanae, at a distance of only 25,000 light years, is approximately as luminous intrinsically as the faint irregular galaxy IC 1613, at a distance of about 750,000 light years

Involved in the star fields of the individual galaxies, especially in those of spiral and irregular form, are both bright and dark nebulae, and groups of stars in all degrees of organization, from the compact million-starred globular systems and the clusters of the open Pleiades type, to the multiple stars and simple binaries Not so easily recognized as stars and nebulae is the widespread interstellar and perhaps intergalactic medium which is composed of electrons, atoms, molecules, and particles—the material (mostly lightless) that causes the absorption, blocking, and scattering of light

This universal background stuff may be the most significant feature of the physical universe, with the stars only a phase that has monopolized human attention because they generate a radiation, as a result of concentration of mass, that happens to affect strongly one human sense organ Analogously we have until recently considerably over-rated the little segment of the spectrum from violet to red which our eyes recognize To the "short" of violet and the "long" of red are the energies that empower and reveal the universe

All of these material entities, from interstellar atoms, through stars to supergiant galaxies, are of interest in the study of the structure of the Metagalaxy , but our attention will be given in this paper mostly to the galaxies themselves, since they permit us to explore the depths of space more extensively than do the individual stars or the interstellar gases

The average separations of stars one from another is much greater, compared with their linear diameters, than the relative separations of galaxies In ordinary regions of the Metagalaxy there is less than a hundred galaxy-diameters from one system to the next, and in some rich regions there is an average separation of not over ten diameters , whereas from star to star in the neighbourhood of the Sun there is an average separating distance of more than ten million Sun-diameters

In each galactic system we find a considerable variety among the galaxies, especially in size and structural organization But the inaccessibility of most galaxies, and our scanty knowledge of those within range, has led us to classify them into relatively few types—the spheroidal , the spiral , the irregular , and the as-yet-unclassifiable, which is of course an enormously large group containing more than ninety per cent of all now known Distance, with consequent faintness and small dimensions on our photographic plates, hides from us the structures of most of the galaxies that appear on the long-exposure photographs made with the telescopes most suitable for the recording of galaxies Such remote objects can be described only on the basis of shape and central concentration Fortunately, however, a few thousand of the galaxies are near enough to permit somewhat detailed classification and analysis We like to think that they are a fair sample of all the galaxies within a thousand million light years

Our sketchy metagalactic picture can be concluded with a reference to the red shift in the spectra of external galaxies—a shift that is highly correlated with apparent brightness and therefore with distance, and which has thus led to the Hypothesis of the Expanding Universe That the hypothesis is correct, and refers to all of the space we survey, is probable, but not conclusively demonstrated If we accept the hypothesis, we can refer to the age of the expanding universe We find evidence that a few thousand million years ago there was an important epoch in history—an epoch that saw the beginning of the rapid expansion, the beginning also of the Earth's crust (and of the Earth itself), and a primitive arrangement of the star clusters in our own galactic system How much of the evolution of stars and galaxies has occurred since that hypothetical zero-point in time, we are not yet ready to say Observations such as those summarized in the following sections of this paper should eventually contribute to our knowledge of the inter-relation of Time and Change in the Metagalaxy

Progress in a Metagalactic Survey

For a score of years one Harvard telescope in the southern hemisphere, the Bruce 24-inch refractor

(Fig. 1), has been accumulating photographs, each of three hours exposure on large fast-emulsion plates, as a part of a comprehensive survey designed to advance knowledge of the external galaxies in the southern and equatorial sky. Ten years ago a similar photographic doublet, the 16-inch Metcalf telescope, was moved from the Cambridge station to the new Oak Ridge station of the Harvard Observatory and there we undertook to cover systematically the northern sky as a part of the same metagalactic survey. In Fig. 2 we reproduce a map of the whole sky on an Aitoff projection—a projection which for most of the sky gives an equal number of square degrees for each square inch on the map.

The survey, as indicated by the figure, was more than three-fourths completed when in 1942 the work slackened because of war emergencies. The power of the plates varies somewhat over the sky because of atmospheric and seasonal variations, and because of inequalities from year to year in the speeds of photographic emulsions. But since plates of low quality are systematically repeated, we can claim a fair degree of uniformity for the survey. The aim is to photograph the stars of the whole sky to magnitude 18.0 ± 0.2; such photographs give in general a complete picture of the distribution of external galaxies to magnitude 17.5 ± 0.2. The corresponding distance in parsecs to which the survey reaches for an average galaxy in high galactic latitude, where space absorption is small, is computed from

$$\log d = 0.2\,(17.5 + 15.2) + 1$$

when, in a survey limited as this one is by apparent brightness, we take -15.2 as the average absolute photographic magnitude of a galaxy. The distance is 35 megaparsecs, or approximately 115,000,000 light years.

The calculation refers to average systems only. The giant and supergiant galaxies will, of course, appear in our census even when they are much more remote than 35 megaparsecs. Some as distant as two hundred million light years are recorded. But occasionally dwarf galaxies at a distance of only fifty million light years are too faint intrinsically to appear in our census. Most of the galaxies have luminosities distributed so closely around the mean that we can fairly say that our survey covers metagalactic space to a distance of a hundred million light years. In low latitudes, however, where the brightness has been dimmed by interstellar space absorption, the survey does not reach so far, and near the galactic circle it reaches nowhere at all because of the complete blocking by the clouds of obscuration along the Milky Way.

Fig. 1. A portion of Harvard Kopje, Orange Free State, South Africa. On the right is the 24-inch Bruce refractor which has photographed several hundred thousand faint galaxies.

The long exposure photographs now available in the eighteenth-magnitude survey show approximately half a million galaxies, more than nine-tenths of which are first recorded on these two series of plates. The completed survey, which will include many repeats of earlier photographs, should put on record, and into our statistical analyses, something more than seven hundred thousand galaxies, of which perhaps twenty per cent lie beyond the one hundred million light year limit. If it were not for low-

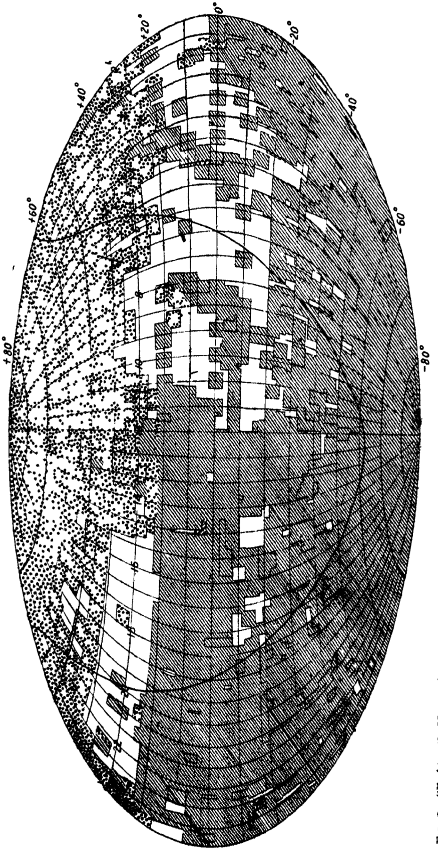

FIG 2 "Eighteenth Magnitude" metagalactic survey North is at the top Right ascension increases from right to left, as indicated along the line indicating declination +30° The galactic circle is shown by the heavy curve Dotted areas are those covered by the Metcalf plates made at the Oak Ridge Station of the Harvard Observatory

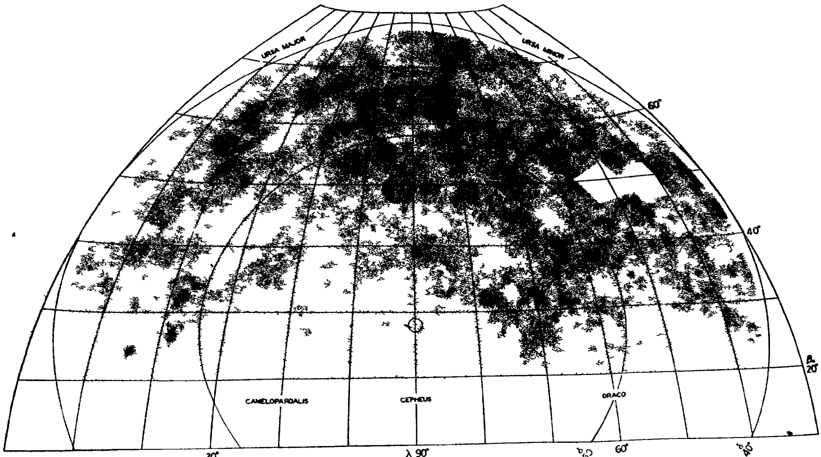

FIG 3 D str but on of 78 000 faint galax es in the northern sky Polar s s n the small circ e below the centre of the d agram Galact c lat udes and longitudes β and γ and decl nat ons δ are nd ca ed by the coordinate systems but not righ asce s ons D s ribut onal rregular t es are attr butable n part to space absorpt on

latitude space absorption, the number within this distance could be nearly doubled In other words, we find that at least a million galaxies are within a hundred million light years of the Earth

If the mass of an average galaxy, including the interstellar material of its domain, is 10^{10} times that of the Sun, the mean density in space is

$$\rho = 5 \times 10^{-30}\ g/cc$$

throughout this surrounding volume of 4×10^{24} cubic light years in a lower limit We have probably underestimated the number and mass contribution of the dwarf galaxies that because of faintness will not be recorded in the Harvard survey, and possibly also we have underestimated the mass of interstellar material A value $\rho = 10^{-28}$ g/cc is probably a better value

Out to the greatest distance where an average galaxy could still be photographed with the largest reflecting telescopes, there should be at least two hundred million galaxies That distance is something like six hundred million light years, if space is effectively transparent in these outer regions

A supergiant galaxy like our own system could, however, be photographed with many of the telescopes now existing at double that distance No doubt we have with the Bruce telescope already recorded objects a billion light years away, but we have not identified the specific images of such galaxies among the thousands at the magnitude limits of our photographic plates We deduce their presence statistically

An Atlas of Northern Galaxies

In the northern part of the constellation Virgo is a well-known cluster of some two hundred bright galaxies, with magnitudes ranging mostly between 10 5 and 14 5 The diameter of the main body of the group, which is centered on R A $12^h 30^m$, Dec $= 12°$, is some 10°, but there are many outlying systems that, on the evidence of comparable brightness, could reasonably be assigned to this large cluster or cloud of galaxies The most conspicuous extension of the cloud is to the south, through Virgo to the constellation Centaurus, at Dec $-30°$—giving a total extent of some five million light years

To the north of the Virgo cluster is a wide scattering of bright galaxies, covering the north galactic pole in Coma, and spreading over the constellations of Ursa Major and Canes Venatici In our general study of this important northern region, we have photographed not only the bright galaxies, but also the background upon which they are superimposed It is possible, therefore, to present, in the diagram, Figure 3, a plot on an equal area projection of the distribution of faint galaxies over all that area lying north of declination $+40°$ in higher galactic latitude than $+20°$ The survey plates were made with the Metcalf telescope at Oak Ridge, with three-hour exposures on fast plates

The total of approximately 3600 square degrees covered by this survey contains about 78,000 galaxies to the magnitude limit of 17 6 Before making the diagram showing the distribution of the faint galaxies, all the plates have been reduced to a common magnitude limit Appropriate allowance has been made for overlapping of plates, but no attempt has been made to plot accurately the positions of individual galaxies within each square degree, as a result, we have an axaggerated smoothness in the plotted distribution The many real clusterings and other irregularities, however, are clearly shown In particular, it is easy to see the effect of space absorption on the number of photographable galaxies in galactic latitudes from $+20°$ to $+30°$ A few regions in this large cloud of galaxies remain to be analyzed, and the conspicuous clusterings are now under special investigation with the aid of the Schmidt reflector at Oak Ridge

A preliminary examination of the dependence of the number of galaxies in this part of the northern sky on the galactic latitude is assisted by Figure 4,

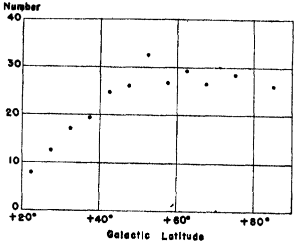

FIG 4 Illustrating the effect of space absorption on average number of galaxies per square degree

where the average number of galaxies per square degree is plotted for five degree intervals of galactic latitude (For latitudes greater than $+75°$ the material is supplemented with observations not represented in Fig 3) There appears to be no certain dependence on latitude above $+40°$ Below $+40°$, the number of galaxies per square degree falls off rapidly—more rapidly, in fact, than in most other parts of the sky This evidence of strong space absorption for latitudes between $+20°$ and $+40°$ in

the northern sky corresponds to the "flare" of absorption in Cepheus, previously pointed out by Hubble,[1] and later confirmed by researches on the North Polar Cap by Shapley and Jones[2]. This Cepheid flare extends over the North Pole of the sky, and produces considerable absorption and some reddening in the important field of the North Polar Magnitude Standards near Polaris.[2] The flare is limited in galactic longitude, as can be seen in Fig. 3.

• It is of passing interest to note that we have photographed 1760 galaxies through the Bowl of the Big Dipper. The galactic coordinates of its center are $\lambda = 110°$, $\beta = +45°$.

The examination of the photographs for the work described in this section has been chiefly in the hands of Miss Rebecca Jones, with assistance from Miss Frances Wright and others; the photographs with the Metcalf refractor were nearly all made by Mr. Henry Sawyer at the Oak Ridge station. Further description of the work will be published elsewhere. The dependency of galaxies on galactic latitude can be better analyzed after the photographic magnitudes of the individual objects have been determined.

The Galactic Anti-center

Diametrically opposite the galactic nucleus, which lies chiefly in Ophiuchus, Scorpio, and Sagittarius, is a less significant, but nevertheless important region of the sky. In the anti-center region we can hope to discover most easily the extent of the Milky Way in its own plane, and effectively explore the outer regions of a spiral galaxy.

Obscuring matter along the galactic circle in Taurus and Auriga, the anti-center constellations, blocks measurements in low latitudes. Any useful distance-indicator requires transparency, or quantitative knowledge of the absorption. By making a careful simultaneous study of Cepheid variable stars and external galaxies in latitudes higher than fifteen or twenty degrees, on both sides of the Milky Way, we can, however, get at least an approximate measure of galactic extent in the direction opposite the center. The periods and brightness of the Cepheids along the borders of the Milky Way give us the first estimates of distances. They give maximum values. The number of faint galaxies give a rough measure of the total amount of space absorption in each field photographed for variables, and therefore, indicates how much correction must be made to the photometrically determined distances of the Cepheid variable stars.

The systematic study of the anti-center variables has been in progress for five years. The region under survey is shown in galactic coordinates in Fig. 5. Several hundred plates have been made for the discovery and measurement of the faint Cepheids. Various photographic telescopes are being used, chiefly those located at the Oak Ridge station; and the most effective for the work, because of large field and deep reach, are the 16-inch Metcalf refractor and the 24-inch Jewett Schmidt-type reflector. The variables previously known and catalogued in the anti-center region are in general too bright and too near, or too much involved in the lower-latitude

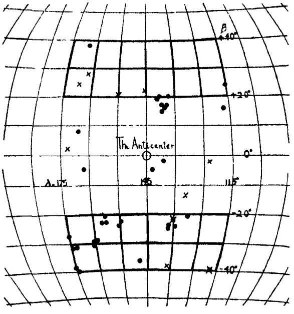

FIG. 5. Diagram showing the two anti-center regions under special exploration for Cepheid variable stars. The cluster variables in this part of the sky that were known at the time the work was begun are shown as dots when brighter than photographic magnitude 12, and as crosses when fainter. Those close to the galactic circle, $\beta = 0°$, are generally too much troubled by space absorption to be useful. More than a hundred new variables have now been discovered in the two regions, and many are cluster type Cepheids.

absorbing clouds, to be useful in this work. The 150 variables, newly discovered for this study by Miss Martha Dowse, are mostly fainter than the fourteenth magnitude, and many are located in the regions where the population of galaxies is sufficient to indicate high space transparency.

Of the new variables, many are of the cluster type, and at this stage of the research, we can report that several are as far from us in the anti-center direction as we are distant from the galactic center. Presumably these faint variables are members of the galactic system, not intergalactic; but some of them may be in the "star haze" surrounding the discoid of the galaxy,[3] rather than in the main body of our flattened spiral system.

Eventually the research on the anti-center region will involve starcounting and the analysis of the

colors and spectra of faint stars, as well as the present exploration by way of galaxies and Cepheid variables

Variable Stars in the Clouds of Magellan

The Magellanic Clouds, as the nearest of external galaxies, are important in our study of the Metagalaxy because of their resolvability, their irregular forms, and their significance in the local cluster of galaxies Their Cepheids are of wide cosmic usefulness They provide much information valuable to the study of Cepheids in our own galaxy Recent investigations in the Clouds have brought out some new facts about Cepheids and have reinforced others already surmised A few are summarized in the following paragraphs

(*a*) Continued study of the photographic plates has increased the number in the two Clouds of recognized classical Cepheids (periods greater than a day) to more than twenty-five hundred A score of irregular variables and eclipsing stars, found and studied on these photographs, are mostly giant and super-giant members of the Clouds, rather than intervening galactic variables Many of them are a thousand times the luminosity of the Sun[4]

(*b*) About a dozen cluster-type Cepheid variables (periods less than a day) are found on the photographs of the Small Magellanic Cloud, but probably without exception these objects are all superposed No cluster variables that are definitely members of either Magellanic Cloud have been found, notwithstanding the use of special series of plates with the 60-inch reflector at the South African Station Certainly such stars are very rare in the Clouds, in striking contrast with the situation in the galactic system where the cluster type Cepheids are much more abundant than the classical Cepheids

(*c*) In the core of the Small Magellanic Cloud are many classical Cepheids with periods abnormally long—ten to twenty days—with scarcely any of the dominant period length, that is, of two to five days A similar scarcity is shown in our accumulating data on the globular star clusters, and it is especially conspicuous for classical Cepheids in the direction of the galactic center, where the "16-day Cepheid" is especially dominant In all three regions[5] the star density is high This peculiar distribution of the periods is doubtless a matter of evolutionary significance in the history of rich stellar systems

(*d*) Certain regions of the Small Cloud have been thoroughly studied for the magnitudes and periods of the variables Selection on the basis of period or brightness is thus eliminated The distribution of the lengths of the periods in these thoroughly explored regions is shown in Fig 6

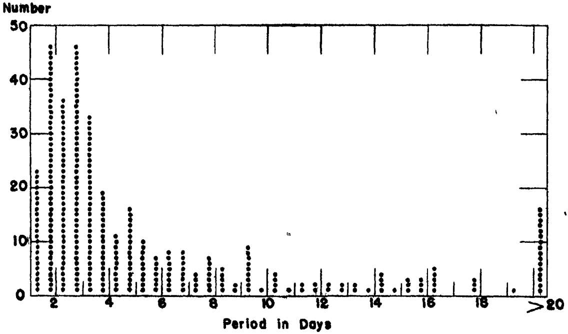

Fig 6 Distribution of periods of classical classical Sepheids in the Small Cloud

The maximum frequency appears for periods of 2 5 days, whereas, for the regions in the solar neighbourhood, the maximum is between four and five days The contrast is in small part a matter of incompleteness of the surveys in our own galaxy, but clearly

it indicates a basic difference in the Cepheid phenomena in adjacent galaxies

(e) As a further result of the study of the periods and light curves of more than five hundred of the Cepheid variables distributed all over the Small Cloud, we have confirmed, as noted above, the fact that Cepheids of longest periods show a preference for the dense central regions, and that the shortest periods predominate in the intermediate and boundary regions This peculiar phenomenon has not yet been established for the large Magellanic Cloud (Fig 7), where much less material is as yet available, and where, very surprisingly, scarcely a variable with period less than 2 5 days has thus far been found

photometric measuring errors, including the doubling effect in the crowded star fields, thickness of the Cloud in the line of sight, and patches of absorbing material within the Clouds

(g) An apparent extension, or wing, of the Small Magellanic Cloud was recently discovered Its distance has now been determined by means of Cepheid variable stars, and it is shown to be a physical part of the Small Cloud—not an independent system at some other distance The wing extends toward the large Cloud

In the investigations of the Cepheid variable stars in the Magellanic Clouds, reported in the foregoing

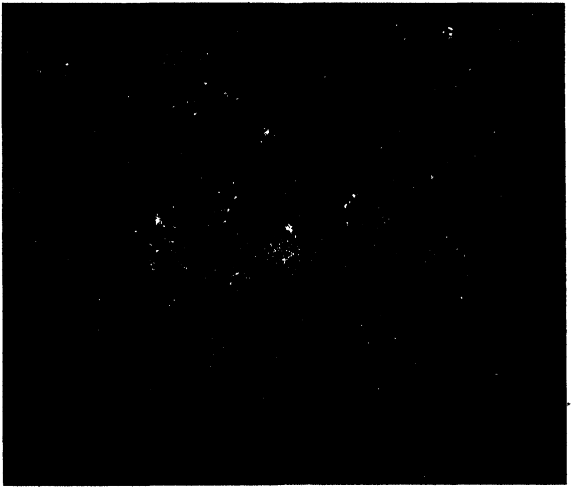

FIG 7 The Large Magellanic Cloud

(f) A detailed analysis of the dispersion of magnitudes about the period-luminosity curve shows that half a dozen factors contribute to the spread in brightness The four most important are the intrinsic differences in luminosity for stars of a given period,

summarizing paragraphs, I have been assisted by Mrs Virginia McKibben Nail, Mr Richard A Craig, Miss Frances W Wright, and Miss Martha Dowse The photographic work in the southern hemisphere has been under the direction of Dr John S Paras-

kevopoulos, superintendent of Harvard's South African station

Distribution of Luminosity in Galaxies

With the assistance of Dr Patterson I have begun systematic studies of the distribution of luminosity over the surface of the nearer spheroidal and spiral galaxies The photographic work has been done at the Oak Ridge station with a flat-field refractor, and the plates have been carefully standardized throughout the processes of exposing, developing, calibrating with the sensitometer, and analyzing with the microdensitometer Several workable galaxies generally appear on each plate About half of the photographs have been reduced and discussed, and a report on one phase of the work has already been published Another discussion will appear in a Harvard Observatory publication Two of the principal results may be summarized in this report

(a) The measurements of a number of spiral galaxies, whose galactic planes are highly inclined to the line of sight, indicate that only about twenty per cent of the light, sometimes much less, of a typical spiral is located in the spiral arms themselves Some of it is in the nuclei, of course, but most of it is in the little-noticed background of the galaxy The evolutionary implications are obvious

(b) The overall dimensions of galaxies of the various types appear to be much alike Earlier studies had seemed to indicate that the open spirals were several times more extended than the spheroidal galaxies But it now appears from the microdensitometry that the spheroidal structureless systems can be traced to great distances from their nuclei The arms of a spiral galaxy (and three-fourths of the galaxies show these spiral arms) appear, therefore, to be concentrations or perhaps condensations within the systems, rather than ejections from a central nucleus In Fig 8 the distribution of the diameters of the various types of galaxies, as shown by the new series of measures, is illustrated, with the abscissae expressed in kiloparsecs[6] The measured diameters of the smallest objects are about six thousand light years, the median value is twice as great, and the largest systems are more than thirty thousand light years in diameter and therefore approach comparability with our own giant galaxy

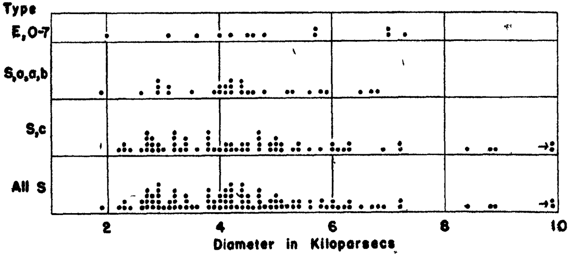

Fig 8 Distribution of dimensions of Galaxies

On the Evolution of Galaxies

From the foregoing new observations on the dimensions of galaxies and the significance of spiral arms, one might provisionally conclude that the open spirals do not necessarily represent the older or more developed state of a galactic system If there is development along the well-known sequence of galaxy forms, it may be in the direction opposed to that usually assumed, that is, in the direction from the most open spiral (Sc) to less open spiral (Sa) to highly flattened spheroids (E7), toward the spherical galaxy (E0). In such a scheme globular clusters like the giant 47 Tucanae, or the still more gigantic globular Messier 87, which is a typical spheroidal galaxy might be considered the end products of galactic evolution One rather colorless argument for this hypothesis is the above-mentioned suggestion that spiral arms may not represent rotational ejection from the nucleus of a developing galaxy, but represent instead merely an inner organization of the nebulosity, star clusters, giant and supergiant stars. But such an interpretation of the arms does not neces-

sarily define the direction of development Positive arguments for a spiral-to-spheroidal trend in galactic evolution are the following

(*a*) Because of the shearing action in the rotation of a galaxy of Glass Sb or Sc (our own galactic system, for instance), the star clusters and star clouds which characterize these open glaxies must be gradually dismembered and the whole system must proceed toward structural uniformity That is, as Bok and others have shown, the evolution of loose star clusters is toward dissolution We have visualized no reasonable mechanism for constructing star clouds or loose clusters of giant and supergiant stars out of the uniform star fields that characterize the structureless spheroidal galaxy If evolution were in the direction of spheroidal to spiral, what could be the mechanism that develops irregular clustering of giant and supergiant stars?

(*b*) The radiant life of supergiant stars is relatively brief, according to current ideas on the atomic generation of stellar energy Spitzer and Whipple have discussed a process by which the red supergiant stars can develop out of dust clouds But such stars apparently do not and cannot evolve in a spheroidal galaxy, since my observations on the giant globular clusters indicate that interstellar dust does not exist profusely if at all in a globular cluster or in a spheroidal galaxy, which therefore a sterile place for production of giant young stars Open spirals and irregular galaxies, on the other hand, are characteristically full of dark and bright nebulosity There the material is available for the birth of giant stars of low density

(*c*) The time required for the transition from a very open spiral, with its star clusters, nebulosity, dust clouds, and supergiant stars, to a globular galaxy from which all this population, as well as the flatness and spiral structure, has disappeared, would undoubtedly be so long as to strain severely the short time scale of about 10^{10} years The short time scale, however, should not be held as conclusively demonstrated, notwithstanding strong evidence favouring it, such as the age of the Earth's crust, the speed of the expansion of the universe, and the present existence of open star clusters in the Milky Way But even within the framework of this limited time schedule one could look at the development of galaxies from the standpoint of different speeds in two different phases, the first being the rapid and explosive adjustment, when the universe was "young"—and adjustment which resulted in sidereal matter aggregating into unit galaxies of many sizes and forms, much as we see them today, and the other phase being that more deliberate dynamical and radiational process that is now going on, and which in the long run must tend to smooth out and perhaps round up both the irregular galaxies and the considerably-nucleated open spirals There is much room here for theoretical analysis

(*d*) Of the five brightest systems in our local group of galaxies, two are irregular (the Magellanic Clouds), of the total group of a dozen, half are irregular—a much higher proportion of chaos-touched systems than we observe elsewhere in metagalactic space If these irregular star clouds were isolated from perturbing giant galaxies like the Andromeda Nebula and our own system, they might eventually become much smoother The Andromeda Nebula and our own galaxy both have faint approaches to sphericity in the apparently spheroidal haze of distant high-latitude stars, which for our system includes the high-velocity "escape" stars of the cluster-variable type But are these spheroidal hazes, which surround the massive discoids, incipient or vestigial?

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THE ROLE OF MATHEMATICS IN THE PROGRAMME OF DEVELOPMENT OF A COUNTRY*

N R SEN

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"WHY do people buy elephant?" Our school mates used to ponder, in our days The huge animals do not work, only they are led in a procession once a year and what enormous quantity they glut! It gave them a great headache and the discussion went on for a time At last an answer came, that people buy elephants in order to sell them Mathematics in India is still living a life of those useless elephants In spite of the fact that mathematics occupies quite an important place in our school and sometimes in the college courses of study and there are a number of good mathematicians in the country the only answer to the question, "Why do people learn Mathematics" that can be given in India now is "People learn Mathematics in order to teach others Mathematics" This is somewhat tragic in consideration of the fact that between the two great wars large possibilities for application of Mathematics to Technical Developments and Industry have been discovered and very well organised attempts are being made in all advanced countries to exploit all opportunities for application of mathematics specially after the second world war A talk in order to be of any interest now has to orient itself in the line how the object of discussion may be useful in the general plan of the Development of Social Economy of the country One may indeed ask this question regarding mathematics "What social purpose is served by mathematics" Can mathematical study and Research be planned so as to be specifically useful in the development of Indian society?

Definite answers can be given to these questions We first note the importance given to mathematics in the school curriculum There is probably no boy or girl going to school who has not to learn the rudiments of arithmetic and simple calculations To the common man the utilitarian side of mathematics is most attractive But the educational experts while introducing mathematics in the school curriculum meant much more than that The discipline of the mind inculcated by the study of mathematics is a valuable part of education and no education is considered complete without this discipline We have further the opinion of a great jurist of this country that for a jurist the discipline of a higher mathematical training is of inestimable value Anyway the school provides us with large number of boys and girls trained in elementary mathematics, which forms the corpus from which the future mathematical experts and teachers have to be drawn From the school the scholars are transferred to the universities which by tradition are our only centres of mathematical study and research

By efforts made mostly between the last two great wars we find pure mathematical thought has created almost a new position for itself regarding its relation to other branches of learning Through symbolic Logic it has established a connection with the Mental Discipline This is the new hand of pure mathematics The other hand stretches towards Natural Philosophy and the Applied Sciences and Technology This hand has been grasped more and more firmly by the striving nations of the world of the present day and the blessings flowing therefrom seem very far from being exhausted at present One may in future hope to find some close link between Mental Philosophy on one side and Natural Philosophy on the other through mathematical discipline

In addition to Natural Philosophy and Technology there are other branches of learning which now lean more and more heavily on mathematics for expansion of their fields of activity Due to specialisation every science is diverging out into branches and experts in different branches have a tendency to get more and more estranged from each other There is a growing endeavour on the other hand for a compensating simplification and better understanding of the basic principles It is here that modern mathematical thought with its everwidening generalisations and deeper grasp of things comes to aid The structure of the unifying principles of the different branches of scientific thought happens to be mathematical. This should supply greater stimulation and secure better recognition of the needs of the study of pure mathematics in all our centres of learning

My object in stressing this point is to point out that research in pure mathematical thought can be neglected only at the risk of getting the fountain source dried up Technological mathematics, it is true, now possesses in its armoury many valuable and powerful weapons but at every real stage of progress newer weapons have to be forged We must also remember that the nonuse of a weapon furnished by pure mathematics at the present day does not really

* An address delivered at a meeting of the past and present students of the Department of Applied Mathematics, University of Calcutta

prove it to be useless When a Greek philosopher drew curious elliptic and parabolic curves on the sands of the Aegian Sea and studied them people thought him to be crazy But the world had to wait for two thousand years before a German philosopher, saw those curves in the sky in the wake of the planets moving round the sun Then did the world really bless those days when the whimsical Greek philosopher regaled himself by drawing those curious curves on the Aegian shores

Coming to the application of mathematics one may ask what aid Applied Mathematics can give towards the development of technical and other sciences in the country We may generally reply that many exact sciences have problems which can be solved only with the help of the complicated mathematical techniques of the present day There are countries with highly developed Industry where manufacturing concerns (*e g* Bell Telephone Company in U S A) maintain departments of Mathematics in which their own peculiar mathematical problems are studied and solved We may not probably expect such conditions in India just now as in those highly developed capitalistic countries But both in the capitalistic and in the socialistic States mathematicians have to play an important role For instance in the various branches of engineering, aeronautics, river training, geological prospecting, meteorology, optics, biology, ballistics, seamanship and aviation the need for mathematics is well-known In fact an important development in many branches in these subjects is possible only with the close cooperation of professional engireers and trained applied mathematicians The mathematician often first forms the project after going through the necessary calculations and the engineer designs and carries out the plan This cooperation is most essential for progress in aeronautics and an examination of the panel of experts connected with Air Ministry in every country shows this In our days one may indeed come across engineers who are at the same time applied mathematicians of very high order The names of Prandtl (Germany), Karman (Germany-America), and Timoshenko (Russia-America) are well known to engineers as well as to applied mathematicians Larger and more extensive cooperation of applied mathematics with technology has multiplied the number of such experts in industrially developed countries The system which has grown up in those countries has been to utilise the services of men trained as mathematicians for the solution of mathematical problems which arise in connection with technical developments Naturally, some knowledge of technological practices is then, necessary on the part of the mathematician for the solution of his problems, and this has given rise to a class of specialised mathematicians described by such names as "mathematical technologists", "mathematical engineers," who are in a general way acquainted with the materials they have to work with and the techniques of their particular branches The idea has been to leave the mathematical problem to the mathematician but acquaint him with the conditions under which he is to find a solution which would be useful to the technicist In India, generally a different method has been followed The trained technicist has to learn mathematical processes and acquire some mathematical skill so as to be able to solve the mathematical problems he has to face But the mathematical techniques of the present day are varied and complicated and can be learnt only through long study and application This generally makes the office of the mathematician in technical development a real necessity In any plan of national development the technical expert, wherever he has to face a serious mathematical problem is to be aided by a specially trained mathematician In this connection it will be interesting to quote a passage from the address given by Compton before a meeting of the Royal Society of London describing the organisation of the different Departments for an all out war effort in U S A during the recent World War Regarding the part played by Mathematics he reports thus*

"In addition to the nineteen of N D R C there are two panels concerned respectively with Applied Mathematics and Engineering The difference between a division and a panel is suggested by the fact that the Fire Control Division for example is concerned with development of fire control instruments, whereas, the Applied Mathematics panel is not concerned with the development of Applied Mathematics as such but rather with the use of mathematics to aid in accomplishing the objects of various divisions For this reason the Applied Mathematics panel includes membership on each divisional committee in which Applied Mathematics is likely to be important " The part which mathematics can play in a scheme for the development of a country has been very clearly set forth here If a large number of divisions require mathematics for their progress in work the best effect is obtained by leaving the mathematical problems to professional mathematicians in every section of work rather than by demanding from experts in other branches of science an acquaintance with the complicated mathematical techniques of our day

The training of such mathematical experts is a very important thing which should not be neglected The Universities and the Technological Institutes should develop Departments or sections of mathematics with special emphasis on those branches which have reference to a general scheme of National

* Compton, K T, *Proceedings of the Royal Society of London, A, 182,* 1 (1943)

Planning These sections may start with graduates, preferably Honours graduates in mathematics, and impart to them regular courses of instruction in General mechanics, Theory of elasticity, Hydromechanics, Electricity, Numerical Analysis, Probability and Statistical Calculations, Ordinary and partial differential equations, and generally mathematical techniques applicable to mathematical physics and technology Special emphasis should also be laid in cases of selected groups of students on the mathematical problems of Engineering, Aeronautics, Advanced elasticity and plasticity, Geophysics, Dynamical meteorology, Thermodynamics and on different branches of mathematical physics such as Quantum mechanics, Statistical mechanics, Theory of Relativity and similar subjects The primary object of the general course should be to supply a basic training in Applied mathematics which should include practical work in mathematical laboratory and handling of machines and instruments of general use Many amongst us have experience of work in a calculating laboratory which we set up in this Department about twelve years ago But a bigger scheme with much extended scope of work is now necessary to have our system geared up to a new National Plan providing for large technological developments Some of us at least know very well that technological and also physical problems lead in their turn to mathematical problems which are very often intractable by the standard methods of solution at our disposal They have to be treated by numerical methods in Calculating Laboratories Some of the students of this Institute trained in Numerical mathematics were utilised in this manner by the Ordnance Department during the last war Latest development in this respect are the very high speed calculating machines which may come to be of use in this country also Graduate trained according to the above scheme may be called upon to do mathematical work involving skilled practice or purely research work on technical problems Instruction in Applied Mathematics on these lines is imparted at present in several Universities in England and America and was also a special feature of many German Universities after the first Great War

I must also refer to the organisation of Scientific and Technological training and of Research in India the schemes for which are being proposed or are partially on the way of operation This is also connected with the question of our prospects in this country as mathematical graduates The consideration which Applied Mathematics is receiving in progressive countries will be clear from the following extracts taken from a recent article on "A Federal Program in Applied Mathematics" in U S A (*Science* Vol 107, March 12, 1948) by J H Curtiss

"The growing importance of mathematics, particularly applied mathematics, is one of the most significant trends in science today This trend is part of a broader and necessary development in the physical sciences Thus, the Steelman Report (1) notes that the national research and development budget for the fiscal year 1947 in the physical and biological sciences alone was approximately $1,200,000,000, excluding expenditures for atomic energy The Federal Government's share of this total was $625,000,000 of which $200,000,000 was spent in government laboratories Even larger allocations for research and development are recommended for the future

"Because of the growing mathematical complexity of current problems in the physical sciences, the national research and development program carries with it substantial requirements for research and services in applied mathematics and related numerical techniques This is particularly true in the case of the Government's part of the program, for at present a large fraction of it is concerned with the problems of national security, many of which are highly mathematical Considerations of economy in Federal expenditures, on which so much emphasis is now properly being placed, add impetus to the full exploitation of the mathematical approach Mathematical analysis prior to expensive laboratory experimentation or the construction of elaborate models is economical, both in actual costs and in the utilization of scientists*"

"The National Applied Mathematics Laboratories of the National Bureau of Standards have been recently established with the aim of strengthening the national applied mathematics effort A particular concern of the new organization consists in promoting the rapid development of automatic computing machines and in taking steps to insure their most effective use when they become generally available "

"It seems apparent that there is a definite need for a central mathematical laboratory in the Federal scientific program The organization should carry on a rather specialized set of activities chosen with the view of supplementing and supporting the existing research work in applied mathematics The activities of the center could profitably include consulting services at the level of the applications and the production of aids for such consulting services (such as technical manuals), computing services and the production of aids to computations (such as mathematical tables), and a coordinated program of automatic computing machine development and research in associated branches of mathematics

This need was the basis for the establishment of the National Applied Mathematics Laboratories as a division of the National Bureau of Standards "

* The work of the Mathematical section of the Punjab Irrigation Department will bear testimony to this (*N R S*)

The need for a thorough training in Applied Mathematics has been felt only recently in Great Britain Referring to this A Erdélyi and John Todd write in *Nature* (Nov 16, 1946, p 690)

"The truth is that in recent decades there has grown up a new type of research worker—Dr N W McLachlan has called him the mathematical technologist—and so far British Universities have not provided very much for him An urgent need thus arises for an institution where students are instructed in advanced mathematical techniques not usually included in university curricula, yet needed in mathematical technology (and mathematical biology or economics for that matter) and where they are introduced to research The need for such an institution, which we may call an Institute for Practical Mathematics, was pointed out in a recent article which, evaluating the war-time experience of the Admiralty Computing Service, came to the conclusion that such an institution is necessary both to teach potential customers of the industrial mathematician to state their problems in a suitable way, and also to ensure that the mathematician will be able to tackle these problems in a practical manner "

"Among the principal functions of the suggested Institute for Practical Mathematics we may mention short courses for engineers and others , advanced courses for mathematicians , research , and the preparation of monographs

"Engineers, biologists, economists, and other potential customers of the practical mathematician should be given instruction in routine techniques In addition, they ought to attend courses of a broader character in which they would get a general idea of methods of modern practical mathematics without learning any details, see what types of problems are accessible to mathematical treatment, and learn to formulate their problems in a suitable way Engineers lacking such training have been known to give up a problem as a bad job because it did not seem to be amenable to the mathematical methods with which they were familiar yet, had they only known it, there was an efficient method of dealing with the problem, a method though, which requires a specialist and is outside the reach of a general practitioner of applied mathematics Still worse, in some cases the engineer 'over-simplifies' his problem in order to make it accessible to what he considers the appropriate technique and thereby makes the work more cumbersome, if more elementary, and the result of less practical value The purpose of the mathematical training of an engineer (and on a higher level that of a practical mathematician) should not be to provide him with the detailed working knowledge of as much of mathematical technique as possible within a given limit of time ; the aim should be to give him a detailed working knowledge of the most frequently used routine techniques, together with a comprehensive survey of what a mathematician can do for him, and also to teach him how to collaborate with the mathematician when occasion demands it "

In India Statistics is the only branch of Applied Mathematics which has received some recognition from Industry and the State It is to be regretted that even the Scientific Establishments in India have yet taken no notice of the possibilities of aid which Applied Mathematics can render them There are several Research Institutes of repute in India in which aid of trained mathematicians is likely to be useful Among them only the Tata Institute of Fundamental Research has actively associated mathematicians in the program of its work It is surprising to find that even an Engineering Institute of India instead of strengthening its mathematical section for a more thorough training of its students (I mean of future engineers who are to design for themselves) in mathematics has come to consider its department of mathematics unimportant for Engineering and allowed it to shrink The All India Institute of Technology which is to be established at Hijli has recently advertised for its staff There appears to be no provision for a Department of Mathematics in it now Yet it is supposed to be an M I T scheme The Indian Union expects that her future engineers should be able to design everything which the Union would need and not in any way depend on blue prints from other countries Would this be possible if we ignore the newer developments which are taking place in the advanced countries at the present day? The Indian mathematicians insist that their business is not merely with chalk and board in lecture rooms as some people used to think before, in addition to cultural it has a productive side also which has got to be recognised I myself have the knowledge of how a proposal for the extension of a Mathematical Laboratory of an Indian University was received very unfavourably and even objected to about two years ago by an Indian administrator who came to examine the University proposals on behalf of the Government, on the ground that while he studied mathematics at Cambridge (more than twenty five years ago !) he had seen no mathematical laboratory there These are really discouraging thoughts for the mathematical graduates of this country In a recent report* on the careers for graduates in mathematics in Britain occur these lines "Mathematicians entering the Executive class of the Civil service may obtain appointments not only under the Post Office but in Inland Revenue, and more rarely as cartographers But Cartography leads us

* *Mathematical Gazette* (London), *31*, 294, 1947

to Survey, Survey to Meteorology and so to the whole gamut of posts for scientific officers The National Physical Laboratory at Teddington has set up a Mathematical Section which is concerned with Statistics and with the application of different techniques of numerical and mechanical methods of attack to the problems raised by other sections It exhibits a keen interest in the development of these techniques and an appreciation of the vivifying effect on routine work of research into the more abstract problems raised" The Indian National Laboratories have yet not called in the aid of mathematics by opening such sections It would certainly be imprudent if not suicidal if the experiences of other countries in this line be left unheeded in any scheme of social development of our country We may again ask the question of the days of our boyhood Will the elephants be made only to line up for procession? Or will the strength in them be utilised to give us Power and Work?

INDIA'S NEED FOR INTERNAL COMBUSTION POWER

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THE problem before the country is how to increase the per capita income and raise the standard of living of the common man

The 20th century Fund gives the answer to this vexed question [1] As a result of a survey it points out that the national income of U S A has increased 27-fold within a period of less than 100 years, while the use of energy has also increased at the same rate, U S A now using 300 times more energy from fuels and falling waters than it did in 1850 It has brought to light the interesting fact, that the energy expended to produce 1 dollar of national income has remained stationary at 2 to 3 H P hours without showing any signs to go up or down This proves that the surplus energy saved owing to the enormous improvement in machinery and manufacturing processes, has gone on providing more and more amenities, and thus raising the standard of living of ordinary men and women

Both the objectives that India has set out to achieve to-day have been achieved to a remarkable degree in U S A by the extended use of energy The output of energy per capita per annum or "Energy Index" as Prof Meghnad Saha calls it is 3000 units for an average American whereas it cannot be more than 90 units for an average Indian [2] The income of an American is 20 times more than the income of an Indian because 20 times more power are placed in his hands Thus we see the annual income, and standard of living are directly geared to the energy index

It has been pointed out that nearly a large percentage of the annual energy or horse power output of America is from Internal Combustion Engines With world's demand for petroleum at the rate of about 1 million tons per day America nearly consumes ·70 per cent of oil Modern civilization is so much indebted to internal combustion engine that it can be conveniently taken as a standard to measure the industrial progress of any country Judged by this standard India is far below even countries like Canada and Australia which took to manufacture internal combustion engines as a War measure

The most outstanding achievement of Internal Combustion Engine research in recent years as Ricardo points out is the development of the "High speed Diesel Engine—a power unit using relatively high boiling fuels such as cannot be vapourized outside the cylinder " The low fuel cost and the high thermal efficiency combined with compactness and safety have made the use of Diesel units universal They have an important role in the power development of the country in general and rehabilitation of agriculture and small scale industry in particular

Nearly 10 per cent of the total installed generating capacity of public utilities in India is Diesel power * The installed capacity of Diesel Stations in 1930 was only 10,000 k w whereas in 1943 it was 119,262 k w showing nearly a 12-fold increase The consumption of Diesel and other fuel oils has shown a sharp increase Of the total imports under oils valued at 80 crores in 1945 showing a rise of 44 crores over the previous year's figures the Diesel and other fuel oils accounted for nearly 20 per cent

The following table gives a rough idea of the number of oil and gas engines and their component parts, and the amount of diesel and other fuel oils

* In addition there are large number of private power plants catering to various small scale industries spread all over the country, an estimate of which is difficult to make

together with the value, imported into India during the last three years

TABLE I

(Compiled from various sources but mainly from reports of the India's Sea Borne Trade issued by the Department of Statistics and Commercial Intelligence, Government of India)

Year	Number of Engines Imported	Value (in millions of rupees)	Diesel and other fuel oils imported (in million gallons)	Value (in millions of rupees)
1944	438	2 54	252 98	64 42
1945	758	4 29	380 04	106 80
1946	2887	14 13	246 66	87 06

From the table we see that the imports of engines and fuels have shown a steady increase and India is spending nearly Rs 10 crores on this account This shows that Diesel power generation has come to stay and has a very important role in the industrial set up of the country

The power development in India has been so far devoted to satisfying the power needs of big industries in cities Over 42 per cent of the electrical power generated in India is at present utilized in the cities of Bombay and Calcutta If Cawnpore and Ahmedabad be added to the above, we find that over 50 per cent of the output of the Indian Electrical Industry is absorbed in these four cities which contain less than 1 5 per cent of population, on the other hand out of 7 lakhs of villages only 1200 villages have electric service of any sort

India is essentially an agricultural country with 80 per cent of its population living in villages It is to the succour of these villages we have to turn our attention India's wealth is in a overwhelming degree in her agriculture and the whole structure of her economy rests with her cultivators What is needed is to increase in desirable directions the number of villagers' wants, and to show them how to satisfy these by their own efforts and thus increase the purchasing power and the wealth of the country in general

Agriculture is of all the industries the one that use in the aggregate the most power, more in fact than all other industries put together [3] Now power is supplied mostly by men and animals We have to relieve man from the back-breaking toil, and reduce the pressure of the animal on the soil by substituting power in its stead In 1920 every agricultural worker in U S A had an acreage of 35 acres against 18 in 1870 While the power used in agriculture has increased from 1 75 H P to 4 H P *i e*, acreage per man has increased in the same ratio as power employed More interesting from our point of view is the increased yield, the American Farms give, which is nearly 3 times as much as from an Indian Farm

In any scheme for increasing Agricultural Production improvement in yield appears to have greater possibilities than extending the area under cultivation [4] Of the total area of 209 million acres under cultivation in 1938-39 only 54 million acres were irrigated Under various irrigation projects contemplated it is possible to bring under cultivation another 48 million acres thus leaving nearly 100 million acres of land without any sort of irrigation It is here that power irrigation comes into scene Assuming that 25 per cent of the land is in the proximity to rich coal fields or within an economic distance of high tension lines from nearby Hydro-electric Stations, we will have to provide power for nearly 75 million acres

In Europe and in the United States long established electrically run Farms use on an average upto 22 k w hours per acre per annum which is classified under the following heads, in table II

TABLE II

(Table from Mears and Neale, Electrical Engineering Practice, Vol III, Art 858, Table 182)

	Units k w hours per annum	Units k w hours per acre per annum
Lighting house	100	0 67
Lighting Buildings	150	1 00
Motive power barn and dairy	1500	10 00
Heating and Cooking	1500	10 00
Total	3250	21 70

Nearly 50 per cent of the power we propose to supply to the farm will be utilized for motive purposes that is to say power irrigation or pumping The 22 k w hours per acre includes power used for heating, cooking and domestic purposes Since such a luxury load does not exist in India the surplus energy can be utilized for the development of Cottage Industries For 75 million acres at the above rate we require 1650 million units of power This power has to be supplied from Diesel Stations Table No III throws an interesting light on the amount of energy consumed on the total source energy derived from various application on an American farm

From the table it is seen that the mechanical power supplied is nearly 40 per cent of the total power consumed in agriculture Pumping accounts for 10 2 per cent of the total H P hours consumed against 22 per cent supplied by internal conbustion engines (both stationary and petrol tractors) Thus

TABLE III

(Based on the United States—Department of Agriculture)
Table from Mears and Neale, Electrical Engineering Practice, Vol III, Art 858, Table 181

	Approx % of total H P hr consumed			Approx % of H P hr from various sources	
Haulage work on land	Ploughing	15 8%		Animals	61 3%
	Fitting the ground	6 3%		Stationary Engines	12 3%
	Planting and seeding	2 5%		Petrol Tractors	9 7%
	Cultivating	6 3%		Steam Tractors	6 4%
	Harvesting	5 1%		Electricity	5 4%
	Haying	6 4%		Trucks	3 6%
	Miscellaneous	5 7%		Windmills	1 3%
			48 1%		100 00
Haulage	Farm Haulage	7 6%			
	Road Haulage	14 9%			
			22 5%		
Stationary	Thrashing	7 6%			
	Pumping	10 2%*			
	Miscellaneous	11 6%			
			29 4%		
			100		

* Figure is ours

power irrigation consumes nearly 50 per cent of the internal combustion power supplied which is the basis we have adopted for our estimate

In Table IV is given the total installed and generated capacities of public utility Diesel Stations in India from which we have derived the number of hours of continuous demand in a year

TABLE IV

(Figures taken from H M Matthew—National Planning and Electrical Development in India—*Journal of the Institute of Engineers, India*)

Total installed capacity in k w	119,262
Total generated capacity in million k w hours	153 3
Number in hours in use per annum	1,250

Assuming the same plant use, plant capacity and load factor we find that to supply 1650 million k w hours we require an installed capacity of 1650/1250 *i e*, 1 32 million k w which is slightly more than the present total installed capacity of power in India

The National Planning Committee recommends that if the material conditions of India was to improve substantially within the next 10 years the production of power should be raised by 40,000 million units above the present figure *i e*, a tenfold increase over the present capacity of India. Assuming that Diesel power also increases in the same ratio according to the National Planning Committe we require 1686 3 million k w hours as shown below

The present annual capacity	153 3 million k w hours
Recommended increase	1533 0 million k w hours
Total Power	1686 3 million k w hours

Our estimate based on the electricity per acre agrees with that recommended by the National Planning Committee if we assume that, increase in various types of energy takes place in the same ratio as it exists at present

The areas which are not in the immediate proximity of high voltage lines are to be invariably supplied by diesel engine generators India being a country of long distances, the difficulties of transmission to areas which are scattered in fragments is further accentuated by the comparative load to be expected and even these seasonal and nonexistent for long periods It will take a long time before supply from rural lines connected with the grid will be generally available everywhere Such a system is said to have failed in Britain owing to the costly transmission and maintenance of energy which usually amounts to 40 per cent of the cost of total power generated Just as it may often pay a man to "sink his own well rather than pay for miles of mains" it may pay him to set up his own generating set or a set on a co-operative basis The Bombay Electric Grid has evolved a scheme to supply power to the farmer for watering fields from tube wells sunk in or near the farm on the above lines It consists of

a large Central Station generating electricity by Diesel engines and transmitting the same to drive pumps erected on these wells to irrigate the fields on a mass production basis

The "Gas and Oil" in an Editorial commented as follows "Plans have been lodged with the Electricity Commissioner for further extension of distribution particularly in rural areas (This last development we would add offer excellent scope for the adoption of judiciously placed Diesel Engined Stations) All this can be achieved with far greater rapidity and immediate satisfaction of consumers if large and small oil engine plants are installed in numbers "[8] To develop an economic load and make the people electrical minded in an unelectrified area we have to build small power stations in the first instance of 50 to 500 k w capacity with a transmission line running a length of not more than 10 miles If supplies are required at a greater distance then an additional plant of the same capacity should be installed with its own transmission line This can be conveniently done by Diesel power scheme would work out roughly to 100 crores [10*] Thus a great future lies for diesel engine manufacturer in India

We have all the facilities such as suitable raw materials like iron and steel, non-ferrous metals, and cheap skilled labour for the manufacture of Diesel engines About half a century ago the Western countries and about a decade ago Australia were in the same predicament as India is to-day in regard to internal combustion engines Australia undertook seriously the manufacture of Diesel engines seven years ago as a War measure and the progress is continued to this day by entering into contract with Ruston Hornsby Lincoln covering the Australian manufacture of their models and by an extensive system of subcontracting around the main coordinating and assembly factories she is soon to produce engines of 2500 H P

The internal combustion engine has been developed to the present state of efficiency mainly by hit and miss methods and the manufacturers are withholding a lot of technical information as closely

TABLE* V

PROBABLE AVERAGE DEMANDS AND ESTIMATED COSTS OF DIESEL POWER HOUSES FOR DIFFERENT SIZES OF TOWNS

(Table from R L Vaidya's "Post War Electric Power", Volume 24, No 2, *Journal of the Institute of Engineers (India)*)

Present population of unelectrified towns	Probable average Power demand in k w			Installed Capacity and estimated cost of complete power house			
				Cap for 1st & 2nd stages of demand		Capacity for 2nd & 3rd stages of demand	
	1st stage	2nd stage	3rd stage	1st stage	2nd stage	2nd	3rd
5000—10000	50	100	200	2—50 k w	48000	2—50 k w set 1—100 k w set	Rs 72 000
10000—25000	100	200	300	2—100 k w	71000	2—100 k w set 1—200 k w set	Rs 1,20,000
25000—50000	200	300	500	2—200 k w	121000	2—200 k w set 1—300 k w set	Rs 1,84,000
50000—100000	300	500	1000	2—300 k w	142000	2—300 k w set 1—500 k w set	Rs 2,19,000

units which can be moved from one place to another and changed from one size to another as the load develops

The size of an engine in a particular place depends entirely on the conditions of load at the place But engines in units of 50 to 1000 k w are very economical Table V gives an idea of the size of the units required for various stages of developments contemplated with their approximate costs

From the table we see that India needs about 10000 to 15000 Diesel sets in units of 50, 100, 200, 300, 500, and 1000 k w capacity to meet the estimated demand of 1 3 million k w The cost of such a

* The number of Diesel units required in various capacities and a cost of the scheme has been worked out approximately as follows

There are about 3017 towns in India within a population range of 5000-10000 out of which only 188 towns are electrified and the rest 2829 are 94% unelectrified To develop electricity in these areas for the first and second stage we require 2 units of 50 kw per town, *i e*, we require 5658 units of 50 kw capacity For the second and third stage we require, 2 units of 50 kw +1 of 100 kw per town, *i e* we require in addition 2829 units of 100 kw capacity Therefore for both the stages we require 5658 units of 50 kw and 2829 units of 100 kw In this way we can work out the number of units required for different population ranges given in the table The cost for the first stage works out as 136 millions and for second and third stage 68 millions In this way the cost of the scheme has been computed approximately

guarded trade secrets If we have to build up the industry within a reasonable time we must mobilize the research of various workers now engaged on the production of components to produce complete sets of engines in certain suitable localities Foreign expert help may be sought in design matters for sometime As the Committee on I C Engines appointed by the Government of India remark "It must not be forgotten that the development of the I C Engine industry depends on the hard work of a group of people and not on the flash of genius, on the part of a single individual engaged in the industry "[11]

To meet the demands of the Diesel power stations a new fuel industry will have to be built up Our fuel requirements will be of the order of million tons per annum which at the pre-war price amounts to about 70 million rupees The Board of Scientific and Industrial Research has succeeded to a large measure in its experiments to use vegetable oils as a Diesel fuel and as a lubricant, but the high cost has stood in the way of their universal usage There are various alternative fuels in a tropical country like India which will become fruitful sources of supply if concerted research is directed towards them

It has been accepted that agriculture is the least paying of all industries and agricultural income has to be supplemented by income from small scale industries pursued side by side With the power available the farm manufacture of agricultural implements and tools taken up , the development of processing of agricultural products and dairy industries will also receive impetus Small scale industries like oil and cane crushing, ginning, flour milling, decorticating, vegetable and fruit gardening, tobacco curing, and a variety of new industries can be developed to feed the consumers' wants In addition lighting and rural water supplies, community radio sets, co-operative cold storage may be established thus increasing the prosperity of the villages

With power developed by locally manufactured prime movers operating on fuels which are abundantly available in all parts of the country we can rejuvenate agriculture and foster small-scale industries and thus make village a self sufficient unit Diesel power will dispel gloom from our villages, illuminate millions of minds with new ideas and new hopes, and will take the country forward to higher standards of living and higher income levels

SUMMARY

To increase the standard of living we have to place more power in the hands of our agricultural and industrial workers The Diesel engine as a power unit has found universal popularity, and can be used conveniently to develop our unelectrified areas It will supply power to irrigate lands and thus increase food production and side by side foster the growth of small scale industries We require about 10000 to 15000 Diesel sets in various units to accomplish a programme of supplying power to 75 million acres of unirrigated land We have every facility to manufacture Diesel engines in India and are only 10 years behind Australia which is manufacturing engines upto sizes of 2500 H P To feed the Diesel engine power plant a new fuel industry will have to be built up India being a tropical country it is blessed with abundant oil seeds to compensate for the lack of mineral oils With the power developed by Diesel engines the villages can be made into self sufficient units to a great extent There is a great need for coordinating research of various producing component parts

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MAGNESIUM—THE ULTRA MODERN METAL*

P N GANDHY

INDUSTRY, so long dominated by steel, is gradually realizing the advantages of light weight as a means of increasing efficiency in movement, whether in handling, transport, or workshop operations Magnesium when substituted for iron and steel saves 75 per cent dead weight The two light metals, aluminium and magnesium, in collaboration are proving how far engineering design can be carried without recourse to heavy metals The development of magnesium alloys in Germany, Britain, and United States began only some 25 years ago, but intense research has resulted in remarkable progress, further stimulated by World War II

Sources of Magnesium

Although the metal magnesium, in its different compounds, is widely distributed throughout the earth's crust, the raw materials of commercial importance are three *viz* magnesite, dolomite and Carnallite Magnesite, the carbonate of magnesium, is the most important source of metal, and has the advantage that pure magnesia (magnesium oxide) can be prepared from it by a "dry" process with the minimum chemical treatment Dolomite has all the advantages of magnesite except for the necessity of separating the lime Isolation of magnesium from sea or salt water has been practised for the past 25 years Magnesium occurs as chloride dissolved in sea-water together with salts of sodium, potassium, and bromine About 770 lbs of brine produce 1 lb of metal

Extraction of Magnesium

Now a days the production of magnesium on an industrial scale is based almost exclusively on the electrolytic process, which consists in the electrolysis of fused magnesium salts, particularly magnesium chloride This process bears some resemblance to the electrolytic extraction of aluminium from alumina, but the cell design is a little different The electrodes are arranged vertically and opposite to each other in the cell, the cathode consisting of iron and the anode of carbon or graphite The electrolyte consists of a salt mixture of suitable conductivity, viscosity, and specific gravity Power consumption of 9 K W H per pound of magnesium is necessary in present practice

A new thermal method using dolomite and ferro-silicon has been developed lately in Canada A mixture of the two, in the form of briquettes, is charged into tubular steel retorts, which are then closed and evacuated On heating in a furnace, magnesium in the form of vapour is liberated and condensed in a removable sleeve fitted to the throat of the retort $2(MgO, CaO + Si = 2\ Mg + 2\ CaO, SiO_2$

Alloying

The tensile strength of pure cast magnesium is only 7 tons per sq inch, while in the extruded condition it is about 13 tons per sq inch But if suitable alloying elements are added these values can be trebled for cast and doubled for wrought alloys Aluminium is the metal most commonly added to increase the strength of industrial alloys Zinc is also used in many alloys, and manganese is useful for increasing resistance to corrosion In standard casting alloys, aluminium is added from 6 to 11 per cent, zinc from 0 to 3 5 per cent, and manganese from 0 5 to 2 5 per cent Alloys with cadmium, calcium, cerium, nickel, etc are in course of development and wood help to open up new fields of applications of magnesium alloys

Melting and Casting

Magnesium alloy melting requires a specialized technique This is made necessary by (*a*) the extremely low density of the alloys, (*b*) the strong affinity for oxygen causing "burning" and necessitating use of suitable fluxes, (*c*) the explosive reaction of molten alloy with water, necessitating use of inhibitors in moulding sand Mostly steel crucible furnaces are used for melting, fired by gas or oil The successful handling of magnesium depends upon the proper use of fluxes which have magnesium chloride base Grain-refining by super-heating is another phenomenon peculiar to magnesium melting Moisture in moulding sand must be kept to a minimum and even this minimum must be prevented from reacting To this end, chemicals such as sulphur, boric acid, or ammonium hydrogen fluoride are mixed with the sand which must be of an "open" nature Die casting is also applicable

Hot Working

Magnesium and its alloys may be extruded, press-forged, and rolled if the temperature is kept high enough and the rate of working is slow The best working range of temperature is between 260° and 360°C By extrusion the relatively coarse-grained

* Summary of lecture delivered to the Scientia, Jamshedpur

cast structure of the billet is changed into a fine-grained fibrous structure and both the tensile strength and elongation values are thereby improved Magnesium alloys are extensively rolled into sheets and strips in mills essentially similar to those used for steel rolling Commonly, the initial material used in rolling is extruded slabs, but cast slabs are also employed The hexagonal crystal structure of magnesium does not permit cold rolling to any great extent but by frequent process annealing, some cold working is not impossible

Corrosion

There is perhaps, more misunderstanding about the corrosion stability of magnesium than any other property It can be agreed that magnesium is chemically active but its position at the active end of the electro-chemical series has unduly prejudiced the minds of engineers In the average rural and industrial atmosphere, magnesium is very stable However, contact with other metals, either external or internally as impurities, gives rise to serious trouble But modern high-purity magnesium and alloys show only surface attack after 6 years in 3 per cent NaCl solution Effective means have been developed for treating the surface of magnesium alloys by which atmospheric and particularly marine conditions can be withstood

Uses

In the years prior to 1939, magnesium alloys were fairly extensively used in the construction of aircraft and aero-engine, for such parts as crank-cases, landing wheels, cowlings, and airframe parts The maximum possible use of magnesium ultra-light alloys in aircraft is now the general policy in Europe and America Applications in the heavy vehicle industry have been expanding Other successful applications have been for binoculars, book covers, scientific instruments, drills, road rammers, and in reciprocating and rotating machines such as compressors, pumps, textile machines, etc World War II has brought about important changes in the production position and plenty of magnesium is now available It is obvious that there is a very great field for increased magnesium alloy applications based on the wider and more imaginative use of the existing alloys It is hoped that India will soon be developing her own magnesium industry for which she possesses the necessary raw materials

Notes and News

ATOMIC RESEARCH IN RUSSIA

INFORMATION has been derived from Spanish sources, including the journal ION (February 1948) and in particular Refael Miralles, author of 'Espanoles en Rusia' The most significant statement is that as long ago as 1944, 51,404 million roubles (more than £1000 million) had been allocated for atomic research in the U S S R Under the direction of Prof V L Komarov, President of the Academy of Sciences in Moscow, work done so far is reported to have included extensive exploration of mineral resources in Siberia, the Urals and the Kazakh Republic (Kazakhskaya U S S R) where it is understood that large deposits of uranium are to be or have been found

In 1943, a special Ministry, shrouded in some secrecy, was set up to study new weapons and methods in modern warfare, including the atom bomb It was called the People's Commissariat for Projectile Armament (Armamento Mortero) The new organisation rapidly expanded and at the beginning of 1945 it had under its control 39 factories and research centres Atomic research was in the hands of a separate department and a large research centre was established in Arctic Russia, in a closely guarded enclosure at Ukhta, contiguous to deposits of radio-active minerals such as uranium and radium The director of this establishment was N A Volkov, and work commenced in 1944 The staff included the most eminent Russian Physicists, such as Profs Kapitza, Semenchenko, Tamm, Alikhanov, and others

The Spanish writer says that progress for a time was unsatisfactory owing to the incapacity of Red bureaucrats and the niggardly financial allocations, which were bitterly criticized by Kapitza himself After the war Stalin is said to have taken a personal interest in atomic research and the name of the projectile Commissariat was changed to Ministry of Cons-

truction of Machinery and Instruments and divided into two sections Some equipment was obtained from abroad, e g, from Sweden and Switzerland, and an intelligence department organized to get information from other countries Arrangements were made for imports of uranium ore from Czechoslovakia, and two huge factories for instrument construction were erected in Yoskar Ola and Uralmashzavod, near Sverdlovsk in the Urals The supply of essential chemicals required in atomic research is the responsibility of the Ministry of Chemical Industry Prof Vacilov is now the President of the Academy and Kapitza remains the real head of the elaborate series of research stations and factories which have now been established for atomic and related research The new Five-Year Plan, beginning in 1946, has provided that new centres of key industries are to be well dispersed, mostly towards the east and remote from dense centres of population

The information manifestly does not extend much beyond the end of 1946, and in August (1946) Molotov (Commissar of Public Relations) expressed the view that within two years Russia would have surpassed Anglo-American achievements —(*The Chemical Age*, May 1, 1948)

CENTRAL LEATHER RESEARCH INSTITUTE

The foundation stone of the Central Leather Research Institute was laid on April 24, 1948, at Madras by the Hon'ble Dr S P Mookerjee, Vice-President, Council of Scientific & Industrial Research and Minister for Industry and Supply, Government of India The Institute will be the sixth in the chain of National Laboratories sponsored under the auspices of the Council of Scientific & Industrial Research

Laying the foundation Dr Mookerjee said "I have great faith in the scientific talent of our country I am sure that in the trials and duties that await us in the new independent India the scientists have a great and noble part to play They possess great opportunities of service to the nation They can not only solve the abstract problems of Nature but also the applied problems of industrial development and progress and by the manner in which they solve them find solutions for many of our pressing economic questions and thus create a new type of National economy in which the millions of our fellow countrymen may have a decent standard of living"

Referring to the activities of the Council of Scientific and Industrial Research, Dr Mookerjee said that processes developed in its laboratories have helped the introduction of new industries The Council was now actively engaged in setting up a series of National Laboratories in the interest of scientific and industrial development of the country

"The leather industry is one of the principal industries of India, as the value of exports of leather from India comes to nearly 3 to 4 crores of rupees per annum The Indian Union produces on an average 21 million hides per annum, of which about 9 million hides are utilised for village tanning India dresses about 8 6 million hides every year, the bulk of which is done in the Madras Presidency and is known as E I Kips These are generally exported to outside countries for being finished into processed leather The export trade on this kind of goods is dependent on India being able to maintain high standards of quality and it is, for this reason felt, that the establishment of an Institute in Madras will go a long way towards the education of the tanners It is definitely in India's national interest to export finished leather rather than raw and semi-finished hides"

Referring to skill of Madrasi tanner, which is based on empirical knowledge and handed over from father to son, Dr Mookerjee said, this skill has received world wide appreciation and the accumulated scientific knowledge should now be harnessed in developing our leather industry along modern lines

"The Central Laboratory will undoubtedly take up large range problems, fundamental, applied and developmental, which are usually not tackled in the Universities for want of funds or lack of facilities Certain types of investigations are also not taken up by the industrial organisations as their solution does not hold out prospects of bringing immediate monetary advantage to the firms The Central Leather Research Institute will fill this gap"

Requesting Dr Mookerjee to lay the foundation stone, Sir Shanti Swarup Bhatnagar, Director, Scientific and Industrial Research said that the Indian leather industry has a historic tradition and there is reference to this industry in the *Rig Veda* Referring to the part that the leather industry is playing in India's national economy Sir Shanti Swarup said "India has the largest herds of cattle in world about 180,000,000 cows and oxen, 50,000,000 buffaloes, 46,000,000 sheep, 58,000,000 goats and 12,000,000 of other kinds, and her estimated leather production which include 20 million cow hides, 5 7 million buffalo hides, 27 5 million goat skins and 17 million sheep skins ranks the highest The Indian Hides Cess Committee has valued the nation's normal production of raw leather at about 19 crore rupees with a present value about twice this Hides and skins, raw as well as tanned, form a big item in India's export trade As a result of partition approximately ⅙ of the bovine population and ¼ of the goats and sheep are included in Pakistan area The production of hides and skins will also be reduced roughly in the same ratio

"The province of Madras occupies a singular position in India's leather industry 20 per cent of the cows, 25 per cent of the buffaloes, 25 per cent of the goats and more than half the total number of sheep in the whole of India are reckoned to be in this province Madras is also rich in vegetable tanning materials such as *tarwar or avaram, amalatas, babul myrobalans, mangroves, divi divi* etc Recently wattle cultivation has also been introduced with good success though it is not yet sufficient to meet the demand" Continuing Sir Shanti Swarup said "India being the largest source of hides and skins in the entire world, has a natural right to play a leading part in this industry All these years she was satisfied with merely exporting It should now be realised that this is frittering away of national wealth Research is said to be the hand-maid of industrial progress and in the case of the Indian leather industry advancement will be possible only through research"

The total cost of the proposed Institute was Rs 28½ lakhs recurring of which Rs 2 lakhs will be received as donation by the industry

SUBMARINE MUD VOLCANOES OFF THE COAST OF KARACHI IN THE ARABIAN SEA

A submarine earth-quake off the Makran coast in the Arabian sea was reported earlier (see *Science and Culture, 11*, 426, 1946) to have been followed by the emergence of two volcanic islands As a result of investigation of this earth-quake by Mr V P Sondhi of the Geological Survey of India, it now appears that the earth-quake was accompanied 'by several remarkable phenomena which it is not usual to find combined in a single occurrence', and that the islands—which are four in number and not two—are not volcanic at all but are crests of anticlines formed by the force of gas which pushed up the thick clayey deposits of the sea floor The detailed report of the investigations will be published in the *memoirs* of the Geological Survey of India, but a very brief and interesting account has just appeared in the *Indian Minerals, 1*, No 3, under the caption "The Makran Earth-quake, 28th November, 1945"

Some of the remarkable features of the earth-quake were the almost simultaneous occurrence of another earth-quake near Rakhni in North Baluchistan It was followed by a great seismic sea-wave which is rare in Indian waters Four new islands sprang up along the crest of an anticline formed by the arching up of the thick clayey deposits of the sea floor by gas pressure One of the islands bears the imprint of earth waves—frozen or fossil earth wave—which shows that the islands were raised up after the main shock had passed One of the most spectacular features of the earth-quake was the great fire near Hinglaj caused by the ignition of a large volume of gas which erupted with such great force that the flames leaped thousands of feet high This was taken as a volcanic eruption and the eruption of the dense smoke from the mud built islands led to the erroneous conclusion that the islands were volcanic and the plastic mud was thought to be lava! The line of these mud-built islands in the Gwadar and Ormara Bays is an extension of the Hinglaj belt of mud volcanoes The islands, according to Mr Sondhi, emerged due to the pressure of gas released by the earth-quake and the areas where this line crosses the isthmuses of Ormara and Gwadar should be explored for the possibility of petroleum Here is an instance how a phenomenon which is often catastrophic in its consequences may yet be, in certain cases, of service to man

SYNTHETIC VITAMIN A

Vitamin A is produced synthetically on a manufacturing scale by Distillation Products Inc, of Rochester, New York It has been available for testing The company has neither explained the method of synthesis nor mentioned the starting materials

Several grams of pure crystalline synthetic vitamin A, an ounce of high potency concentrate crystals were exhibited at a meeting of the American Chemical Society in last April The synthetic vitamin A concentrates are light yellow viscous oils They are totally free from the fishy smell which makes natural vitamin A concentrates objectionable in food and drug products

The structure of vitamin A was first established by Karrer in Zurich Since then the synthesis of vitamin A has been reported from time to time

Kuhn and Morris reported in 1937, a synthesis of material showing growth promoting activity, which showed on bioassay a vitamin A content of approximately 5 per cent Unfortunately, this synthesis has not been found to be reproducible by other workers in Zurich and Russia In 1939, Kipping and Wild claimed to have synthesised vitamin A methyl ether, but this claim has not been substantiated In 1945, Ovoshnik has published an account of the synthesis of vitamin A methyl ether which possesses, biological activity The validity of the product, however, is still doubted by other works in vitamin A field, for this compound has the absorption maximum at 3150A instead of the expected absorption maximum at 3250A

Several attempts were made in London in Heilbron's Laboratory for the synthesis of vitamin A, and

though less spectacular results were achieved, the work was of most fundamental pioneering nature, for Isler and his collaborators in Switzerland working in the Hoffman-La Roche Laboratories have recently announced the successful synthesis of vitamin A on the lines worked up in London, confirming the validity of the lines of thought of Heilbron

The largest scale production of synthetic vitamin A has only been made possible by the discovery of Isler One of the suggestions of novel routes to vitamin A, coming from Heilbron's Laboratory bore fruitful results in Holland in Arens and van Dorp's Laboratory where vitamin A acid and finally vitamin A itself was synthesised by an elegant method , contemporaneously Karrer in Switzerland prepared vitamin A acid

With the synthesis of vitamin A, a master problem of organic chemistry has been solved Years will roll by and it will no longer be an object of wonder Heilbron has rightly said, "after many years, victory has come, and the bitter disappointment will in a few years simply be recorded in the text books of organic chemistry in a few terse sentences "

ALUMINIUM FROM CLAY

BOTH bauxite (impure hydrated alumina) and clay (mainly hydrated aluminium silicate) may serve as sources of purified alumina (Al_2O_3) from which the aluminium metal is obtained by electrolytic reduction In 1941, investigations were begun at the National Bureau of Standards seeking economically feasible methods for the production of alumina from clays The development of two processes at the Bureau makes it possible that this abundant raw material may sometime replace bauxite as a source of the metal and will thus be imperative for the protection of the United States from dependence upon foreign sources of aluminium ore According to Interior Department estimates, 70 per cent of the supply of domestic bauxite has already been consumed The two processes for the recovery of alumina from clay are, the hyrochloric acid extraction process, and the alkaline extraction with a solution consisting of a mixture of sodium hydroxide and sodium chloride In the acid extraction process, developed at the Bureau the corrosion of metallic equipment by acid fumes was overcome by the use of modern plastics, glass, and refractory materials in place of metals The hydrochloric acid process consists in (1) roasting the clay , (2) digesting the roasted product in dilute hydrochloric acid , (3) filtering to 'separate the insoluble siliceous matter from the solution containing the aluminium and soluble impurities such as iron and alkali salts , (4) concentrating the solution , (5) precipitating the aluminium as the hydrated chloride from the concentrated solution by adding hydrochloric acid gas , (6) removing the crystals of hydrated aluminium chloride , (7) washing the crystals to remove adhering impurities , (8) calcining the hydrated chloride to obtain alumina , and (9) recovering hydrochloric acid from the waste products at the end of the process While the process is applicable to nearly all clays, kaolin was used in the pilot plant because of its abundance and accessibility

The alumina obtained by this method has an average purity of about 99 8 per cent The only significant impurities are 0 1 per cent of chlorine, 0 04 per cent of iron oxide, and 0 06 per cent of silica In addition to its use in production of aluminium metal, the alumina produced by this process is superior to any on the market for polishing metallographic specimens Exceptionally good results have also been obtained with this alumina in the preparation of enamels for use at high temperatures, probably due to the extreme fineness of the product The price of producing aluminium by the hydrochloric acid process is at present about twice that from imported bauxite

A suggested commercial process for the extraction of alumina from clay and high-silica bauxites was worked out at the National Bureau of Standards in 1943, but the alkaline process was never taken to the pilot plant stage The fundamental principle of the alkaline process is the conversion of the alumina in the ore to sodium aluminate, which is readily soluble in water In the extraction of alumina from ore as sodium aluminate, there are three principal methods (1) direct extraction of the untreated ore with sodium hydroxide solution , (2) treatment of the ore to give a product containing solid sodium aluminate, which is extracted with water , and (3) treatment of the ore to give a product containing calcium aluminate which can be decomposed with sodium carbonate solution Each of these methods results in a sodium aluminate solution containing soluble silica to the extent of one or two per cent of the alumina present A method has been established of recovering alumina from clay by a lime-sinter process involving extraction with a sodium carbonate-sodium chloride solution The lime-sinter process was improved by utilization of the soda-lite method of desilicating alumina solutions containing silica A means was thus afforded for the production from clay of hydrated alumina, which after calcining was entirely suitable for electrolytic reduction to the metal About 95 per cent of the alumina in the clay is recovered by this method, while losses of soda are small and an advantage of the process is that all steps can be conducted at atmospheric pressure (*Journal of Chemical Education,* March 1948)

PRODUCTION OF ALUMINIUM

BEFORE the last war, Germany's production of aluminium showed a continuous and rapid increase It rose from 21 thousand tons in 1933 to 73 in 1935, two years later it had leapt to 132 and in 1938 the output was 166! The U S A output that year was 130! And in 1943, German aluminium production reached the unusually high level of 320 thousand tons, equal to about 60% of world output

Such development was accompanied by a corresponding growth of the aluminium using industries and wide range of aluminium articles was produced both for the home and foreign markets The country was entirely dependent on imported bauxite supplies

Like Germany, Japan is a substantial importer and consumer of aluminium before 1938 During the last war, however, she developed into the world's fourth largest producer of aluminium In 1943, she produced 150 thousand tons of aluminium, when U S A produced 920 thousand tons Cheap and abundant electric power and plenty of shipping to bring in bauxite from as far away as Greece, and from South East Asia and the Pacific Islands made possible that very rapidly expanding aluminium industry Production, technique, equipment and even operating experience were obtained directly from the U S A, Germany, and to some extent from Norway and Sweden

American production of bauxite increased slightly in the last quarter of 1947 Imports of bauxite declined substantially, with the result that the net total of new supply was lower by 14% The total output in 1947 was 1,215,308 tons (*The Chemical Age, 58*, 587, 615, 1948)

A CYANINE DYE IN MEDICAL RESEARCH

AN orange coloured cyanine dye, the so-called compound 863, is found to cure filariasis in rats, and is now being used with promise on human beings, in Puerto Rico

With the outbreak of the war in the Pacific, tropical diseases caused by parasitic worms took an added significance for Americans because many men of the armed forces were sent to places where such diseases occurred among native populations When the cyanine dyes were tried as a specific against malaria, a number of them showed antimalarial activity but not enough to equal that of drugs which were already available There in 1943, one of the dyes, compound 863, when given by injection, was found remarkably active in killing worm like parasites which give rise to the disease filariasis in rats (*J Chem Education 25*, 233, 1948)

STREPTOMYCIN

The ion-exchange resins have played a significant part in the recovery and purification of the antibiotic, streptomycin, which is now produced on a large scale The Amberlite resins are well known for their wide use in the isolation and purification of alkaloids, amino acids, vitamins and removal of inorganic salts from pharmaceutical products One of the more effective methods used in the final purification of streptomycin employs a column of Amberlite IR-4B, treated with hydrochloric acid, which affords a quick and simple means of obtaining the drug as the hydrochloride Both the sulphate and the hydrochlorides are being elaborately investigated clinically —(*J Chem Education, 25*, 233 1948)

ZOOLOGICAL SOCIETY OF INDIA

The following members of the Executive Council were elected at the annual meeting held at Patna in January 1948 *President* Dr S L Hora, *Vice-President* Prof D R Bhattacharya, *Secretary* Hon Major Dr M L Roonwal, *Editor* Prof K N Bahl, *Treasurer* Dr B S Chauhan, *Members* Dr N K Panikkar, Prof M A Moghe, Dr B N Chopra, Dr Bhattacharya, Dr G D Bhalerao, Dr D V Bal, Dr T J Job It is intended to bring out the first volume of the *Journal of the Zoological Society of India* this year Papers intended for publication, which should either be original contributions or critical reviews of current researches, not published elsewhere, should be sent either to the Editor (at the Zoology Department, Lucknow University, Lucknow) or to the Secretary (at the Zoological Survey of India, Benares Cantt) Persons intending to become members should contact the Secretary

LADY TATA MEMORIAL TRUST

The Trustees of the Lady Tata Memorial Trust announce the award of the following Scholarships and Grants for the year 1948-49

International Awards for research in diseases of the blood with special reference to Leucaemias

1 *Dr Jorgen Bichel*, Denmark 2 *Dr Johannes Clemmesen*, Denmark 3 *Dr C F M Plum*, Denmark 4 *Dr Simon Iversen*, Denmark 5 *Prof Edoardo Storti*, Italy 6 *Dr Pierre Cazal*, France 7 *Dr Guido Totterman*, Finland 8 *Dr Peter A Gorer, England* 9 *Dr Edith Paterson*, England 10 *Dr M C Bessis*, France 11 *Dr A Kelemen* Hungary 12 *Dr &Mrs Paterson*, Christie Hospital and Holt Radium Institute, Manchester, England

Indian Scholarships of Rs 250 per month each for one year from 1st July 1948 for scientific investi-

gations having a bearing on the alleviating of human suffering

1 *Mr Suprabhat Mukerjee*, (Applied Chemistry) Calcutta 2 *Mr Yashwant Balkrishna Rangnekar*, (Biochemistry), Bombay 3 *Mr Gangagobinda Bhattacharya*, (Diabetes), Calcutta 4 *Mr K Ramamurti*, (Biochemistry), Bangalore 5 *Miss V Shanta Iyangar*, Bombay 6 *Mr B K Sur*, (Biochemistry) Bangalore

CHEMISTRY IN ANCIENT INDIA

INDIAN Chemical Society has proposed to compile the History of Chemistry in Ancient and Mediaeval India, under an Editorial Board consisting of senior members of the Society, assisted by whole time and part time officers The Government of India has been approached for a grant of Rs 50,000 for this worthy object The UNESCO, which is also interested in the publication of the History of Sciences as developed in early days in various countries, has already written to the Society for information on the matter

ANNOUNCEMENT

The Third Session of the International Congress of Anthropological and Ethnological Sciences will be held in Brussels and in Tervuren (Belgium) from the 15th to the 23rd, August, 1948

Dr Gopal Singh Puri, Overseas Scholar, Government of India has been admitted to the Ph D degree of the London University Dr Puri worked under Prof W A Pearsall, F R S at the University College, London, and his thesis on the factors underlying the distribution of trees and ground flora in parts of Southern England has been widely appreciated We hope that the Government of India will provide facilities to Dr Puri for ecological survey works and other urgent problems connected with soil erosion in India

DR B MUKERJI, Director, Central Drugs Laboratory of the Government of India and General Secretary, Indian Science Congress Association, Calcutta, has been appointed a 'Corresponding Member' of the Pharmaceutical Society of Great Britain

Dr Mukerji has contributed a great deal towards the drug reform movement in India during the last 18 years and his work in the field of Pharmacology and Pharmacy is recognized both in India and abroad He is a fellow of the Swiss Society for Pharmacology and Physiology, the American Society for Pharmacology and Experimental Therapeutics and the American Pharmaceutical Association

BOOK REVIEWS

Abnormal Psychology—By James D Page, Associate Professor of Psychology, Director of the Psychological Clinic, Temple University Published by McGraw Hill Book Co Inc , New York and London, 1947 Price $4

As stated by the author himself in the preface, the book deals with materials that are usually treated in text books of abnormal psychology In simple language intelligible to all students the author has presented a wealth of facts relating to various forms of mental diseases and has devoted the two last chapters of the book to the consideration of 'mental deficiency' and 'anti social personalities and crime' respectively As regards theories, he has introduced many points of view and has made honest attempts to be fair to the different schools The reviewer however does not agree with the author in some of the observations that the latter has made regarding the psychoanalytical one By the very nature of the subject matter that psycho-analysis deals with, it is not possible to check Freud's conclusions of carefully controlled experiments, but that does not certainly take psycho-analysis outside the pale of Science It is very gratifying to find that the author has very ably presented Freud's Libido theory and has not indulged in the cheap criticism that Freud's theory is only pansexualism

Much more perhaps could have been said on criminal activities but the essential facts helpful for an understanding of the psychology of crime and of the criminal have been enumerated The reviewer is definitely of opinion that there are obvious objections in accepting the pathological criterion of abnormality' with regard to mental disorders The analogy between physical condition and mental condition does not hold It is quite true either people

have cancer or they have not In the former case there is something physical (germs, etc) in them which is absent in the healthy persons, but it cannot be similarly stated that abnormal persons have some additional mental qualities which are not found in the normal

The quantitative and statistical criterion seems to the only valid and useful criterion

The book is an excellent text book and will undoubtedly prove to be of great help both to the students who are beginning their studies of abnormal psychology as also to the teachers guiding them

S C M

Hydrostatics—By B N Prasad Published by Ram Narain Lal Allahabad, 1948 Price Rs 5/8/-

This is the second edition of the book originally published in 1943 The scope of the book has been slightly extended and the whole book has been thoroughly revised Some misprints have also been corrected This edition, like the previous one, covers the entire course which the B A and B Sc students of the Pass standard of the Indian Universities are required to read up There is moreover, an Appendix on Metacentre and Stability of Floating Bodies at the end The book will certainly be found useful by the students for whom it is meant

N S

Meaning of Relativity-By Albert Einstein Methuen & Co Ltd , London, 1946 Price 6 *sh* net

This is the third edition of the book of the same name originally published in 1922 as Stafford Little Lectures delivered by Einstein at Princeton University in 1921 Some important advances have been made in the General Theory of Relativity since that time one of which is the relativistic contribution to the problem of Cosmology, popularly known as the theory of the Expanding Universe The value of this little book in the present edition has been considerably enhanced by the addition of an Appendix by Einstein himself dealing with the Cosmological problem It is a concise but well connected exposition of the nonstatic solution of the gravitational equations and its cosmological interpretation Einstein rejects the cosmological λ-term in the equation which he himself introduced at a time when the nonstatic solution was not known and advocates the adoption of an isotropic model of the universe with vanishing spatial curvature in the present state of our knowledge of the distribution of matter in space furnished by Astronomy This small book will undoubtedly be read with great pleasure by every lover of Relativity

N S

Timber, its Structure and Properties—By H E Desch, B Sc , M A , D Phil , F S I Published by MacMillan & Co Ltd , St Martin's Street, London, 1947 Second Edition Pp i to xxii + 299 Price 18 *sh* net

Wood has been the most popular household and building material from early times but no serious attempt was made to study it scientifically till its importance was realised during World War I Soon after, laboratories were established and research work was undertaken on various aspects of this raw material in different countries especially in U S A , Canada, India, England, Australia and Malaya

In 1938, Dr Desch, presented in a concise form available technical information concerning timber, its structure, and properties, and the book was of great help to the students as well as to the timber trade as it filled a gap in the literature on timber Since then the subject has made further progress particularly during the stress of world War II, and Dr Desch has got to be congratulated for bringing out a second and revised edition of this book soon after his release from Japanese captivity

Running into 299 pages as against 169 of the first edition the scope of the book has been enlarged by adding considerable new material in different chapters Part III dealing with the properties of wood, and part IV on considerations influencing the utilization of the wood have received special attention of the author New features of the book are the addition of chapter XIV concerning wood as an engineering material and an appendix II giving a list of more common tree genera, and the families to which they belong Selected bibliography in the end arranged chapterwise also forms a welcome addition

The book is divided into four parts and contains in all fourteen chapters Part I is concerned more with the fundamentals of wood anatomy outlining the structural and functional organisation of the tree, development and composition of wood, fine structure of the plant cell wall, and characteristic features of tissue system as seen under the microscope in softwoods (coniferous) and hardwoods (dicotyledonous) Part II deals with the practical aspects of the timber utilization and here details of gross anatomical features which are readily visible to the naked eye have been explained These include sapwood and heartwood, growth rings or layers, compression and

tension wood, grain and texture, figure in wood, colour, odour and taste, irritants and lustre All these factors not only determine the usefulness of the timber to man but some are of great help in assessing the quality of timber as well This is followed by a chapter on the identification of timber which has been enlarged by incorporating the card sorting method of identifying timbers as developed by Clarke, Phillips, Dadswell and Eckersley

Part III deals with the properties of wood and naturally here the author has thought fit to add some of the recent researches with special bearing on the influence of micro-structure of cell walls, moisture and defects on the strength properties of timber Moreover the potentialities of stress grading in more economic use of the wood have been indicated Other chapters include as before density, moisture, and conductivity and heat values of wood, the last one having a new paragraph on the energy value of wood in Internal Combustion Engines

Part IV has also been greatly improved as it deals with various practical considerations which influence the efficient utilization of wood Under seasoning, new sections on chemical seasoning and drying of wood electrically have been added Similarly, chapters on defects, preservation, and grading of timber have been improved by adding up-to-date researches carried out in different laboratories The value of the book has been enhanced by the addition of a new chapter on wood as an engineering material including sections on timber connectors and adhesives

The book is liberally illustrated and contains one hundred photographs and text-figures Among new additions are some more photo-micrographs of wood sections and a number of new photographs of timber testing machines as well as of test specimens of wood showing different types of failures The frontispiece has been replaced by a series of photographs explaining the nature of area and linear magnification

Timber is a national asset and no country can afford to neglect its study It is probably hardly realised in this country that during wartime, wood has been used in all conceivable ways Being a biological product, its actual performance is sometimes variable as compared with steel This necessitates intensive research, and in India where there are thousands of wood available in different provinces, this is all the more imperative The book under review should have a wider appeal in this country in view of the growing industrialisation in the wake of freedom Our universities and industrialists should do well to foster both fundamental and applied research on timber so as to harness one of our most important raw products to the best advantage of the nation

S S G

LETTERS TO THE EDITOR

[The Editors are not responsible for the views expressed in the letters]

NUTRITIVE VALUE OF *VANASPATIS*—2

In view of the paucity of accurate information on the influence of vegetable oils and vanaspatis on the utilization of calcium and phosphorus, an investigation was undertaken to study the effect of a few vegetable oils and some of the commonly available vanaspatis manufactured from these oils, on calcium and phosphorus—the two important bone forming elements

The experimental procedure adopted in this investigation was the same as followed by Kehar and Chanda[a] for studying the effect of vegetable oils and vanaspatis on protein metabolism The average results obtained on six animals of each group are given in Table 1, cow ghee group was used as a positive control and fat free group as a negative control

TABLE I

Groups of rats indicated by nature of fat	Per cent absorption of Calcium	Per cent absorption of Phosphorus
Fat Free	−5	7 5
Cow ghee	45	57
Groundnut oil (raw)	40	48
Groundnut oil (refined)	41	47
Dalda Vanaspati (m p 36°C)	39	44
Dalda (m p 40-42°C)	36	44
First Quality (m p 40-42°C)	23	42
Til oil (raw)	39	44
Til oil (refined)	38	36
Temple (m p 41-43°C)	35	28
Rajhans (m p 42°C)	25	30
Cottonseed oil (raw)	33	41
Cottonseed oil (refined)	37	47
Binaula (m p 37-40°C)	34	38
Kotogem (m p 41°C)	29	35

It will be observed that the absorption of calcium and phosphorus is extremely poor on fat-free diet The addition of fat, to a fat-free diet, however, raises the percentage absorption The degree of improvement seems to depend on the nature of fat

If the percentage absorption of calcium and phosphorus of vegetable oils and vanaspati groups are compared with cow ghee group, it will be observed that the calcium utilization was decreased by 9-27 per cent in the oil groups and 20-44 per cent in the vanaspati groups Phosphorus utilization was decreased by 16-37 per cent in the oil and 23-51 per-cent in the vanaspati groups respectively, as compared to cow ghee Datta[1] reported that calcium absorption is 14 per cent less on diets containing vanaspatis when compared to butter fat

If the mineral absorption of vanaspati groups is compared with corresponding oils, there is always found a decreased utilization in the vanaspati groups

The effect of supplementing synthetic B-vitamins was studied in the two groups of rats receiving raw groundnut oil and vanaspati (m p 36°C) as reported earlier[2] Results of supplementation are given in Table 2

TABLE II

Groups of rats	Per cent absorption of Ca	Per cent absorption of P
Groundnut oil raw and B-vitamins	47	52
Dalda Vanaspati (m p 36°C) and B-vitamins	45	51

It would be observed that the calcium absorption was raised by 18 and 15 per cent and phosphorus absorption by 8 and 16 per cent in the supplemented oil and vanaspati groups respectively

Details will be shortly published elsewhere

N D KEHAR
R CHANDA

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Indian Veterinary Research Institute,
Izatnagar, 20-3-1948

[1] Datta, N C, SCIENCE AND CULTURE, *10*, 390, 1945
[2] Kehar, N D & Chanda, R, SCIENCE AND CULTURE, *13* 426, 1948

FRONTS IN SOUTH-WEST MONSOON DEPRESSIONS

IN an earlier note the authors[1] discussed the existence of fronts in Post-monsoon storms

Two storms, one of them crossing coast about 80 miles to the north of Madras and the other 160 miles to the south of Madras, were studied with the help of upper air temperature and humidity data and upper wind data at Madras Upper wind data at other stations in the region was also studied It was found that the temperature and humidity conditions remained practically uniform and that no evidence of any front with temperature and humidity contrasts could be found upto 5 km in either of the storms The storms were fully developed and it was concluded that there were no fronts within two hundred miles of the centre of developed storms But whether there were fronts during the formation stage and later could not be answered, and in order to determine this monsoon depression in the first week of July 1945 was examined The depression developed in the northwest Bay of Bengal and almost daily radiosonde observations round the area, from Vizagapatam, Cuttack, Calcutta, Chittagong and Akyab, were available

Conditions were markedly unsettled in the north-east angle of the Bay of Bengal on the morning of 30th June 1945 It developed into a depression at 20°N and 88½°E by the morning of 1st July 1945 and there was a cyclonic storm at 0230 G M T of 2nd July 1945 centred at 21½°N and 87½°E It crossed coast near Balasore about 0530 G M T of 2nd July and later followed a WNWly course

Vertical cross sections through Vizagapatam, Cuttack, Calcutta, Chittagong and Akyab, and time altitude cross sections for all the stations were prepared

On the 29th July, between 950 and 650 mbs there was a gradual increase of temperature from Calcutta to Vizagapatam (through Cuttack), Vizagapatam being about 2°C to 6°C warmer than Calcutta By 30th Vizagapatam and Calcutta had nearly the same temperature and Cuttack was cooler than either by about 2°C The air at Akyab was colder by about 5° below 800 mbs on 29th and upto 700 mbs on the next day

On 1st July at the time of the ascents the depression was deep and 200 miles east of Cuttack, the place having recorded four inches of rain between 0230 and 1130 G M T that day, and recorded another three inches of rain by 0230 G M T of the next day Cuttack ascent made at 13 G M T was thus representative of the heavy rainfall conditions in the south-west sector of the monsoon depressions Compared to the previous day, temperatures at Cuttack rose between 950 and 300 mbs presumably because of the release of large amount of latent heat of condensation The rise of temperature was only 1°C at 950 mbs but increased steadily with height and was 5°C above 650 mbs Cuttack was warmer than Vizagapatam above 900 mbs by at least 2°C, the difference being 5°C at some levels Cuttack was

also warmer by 2°C to 50° than Calcutta, Chittagong or Akyab between 900 and 700 mbs, but aloft temperatures were nearly the same The colder airmass at Akyab was still present below 700 mbs though it was getting warmer

By 2nd evening the depression was 120 miles north of Cuttack Rainfall had ceased over Cuttack area Temperatures fell from 1st to 2nd at Cuttack below 700 mbs but rose aloft upto 400 mbs At 450 mbs the rise was 4°C Thus below 700 mbs the highest temperatures at Cuttack were attained on 1st while between 700 and 400 mbs they were reached on 2nd Temperatures fell at Calcutta by about 5°C below 700 mbs from 1st to 2nd The winds also changed from ENE on 1st to SSE on 2nd It would appear that the air over Akyab below 700 miles on 30th June appeared over Calcutta on 2nd July At Chittagong also there was a fall of 1°C to 2°C between 950 and 850 mbs from 1st to 2nd At Akyab, however, the temperature rose and the colder airmass was not distinguishable On 2nd air over Cuttack continued to be warmer than that at Vizagapatam by about 3°C

On 29th and 30th there was very little temperature gradient between Calcutta and Vizagapatam and there was no evidence of any front with temperature contrasts The rise in temperature over cuttack on 1st was due to the heavy rainfall and these higher temperatures continued on the 2nd and there was no evidence of any front also on these days Akyab had showed a colder airmass on 29th at lower levels which reached Calcutta on 2nd, but from the synoptic charts it appears that this air could not have reached the region of the depression and played any part during its formation and probably also later Thus there is no evidence of any front with temperature contrast either during the formation stage of the depression or later when it developed into a storm

As the temperatures were highest in the zone of heavy rainfall and decreased to the north and east, the heavy rain cannot be due to the upglide of the air from the north and east

The warm air at Cuttack and Vizagapatam on 29th seems to be of subsided origin Akyab also showed subsided air on 28th

Details will be published elsewhere

S K PRAMANIK
Y. P RAO

The Observatory,
Lodi Road, New Delhi,
30-3-1948

[1] Pramanik and Rao, SCIENCE AND CULTURE, *13*, 36, 1947

BIOLOGICAL AVAILABILITY OF FATTY ACID MONOESTER OF l ASCORBIC ACID

THE use of l-ascorbic acid as an antioxidant for oils and fats whether alone or in combination with other antioxidants has been demonstrated by many workers [1] But the insolubility of l-ascorbic acid in dry fat, limits its effectiveness as antioxidants for fats and oils The fact that esterification of l-ascorbic acid with higher fatty acids like palmitic, stearic etc, renders it fat soluble, and makes its incorporation as such much easier Now the structure to which the antiscorbutic action of the vitamin is attributed might also be affected by the process of esterification It is, therefore, desirable to investigate as to the degree of activity retained by these esters This can very well be tested by the biological assay of the fatty acid esters of l-ascorbic acid with guinea-pigs

Normal healthy and male guinea-pigs (body wt 250-300 gm) were divided into 5 different groups, these were maintained on the following diet consisting of crushed barley—64 parts, crushed gram—20 parts, casein—12 parts, cod liver oil—2 c c, and water to drink *ad lib* When the animals just began to show a steep fall in body weight (after 20-24 days) the first group of animals was given per animal 0 5 gm of synthetic l-ascorbic acid The 2nd, 3rd and 4th group of animals were given an amount of the different esters containing 0 5 mg equivalent of indophenol reducing substances as supplements to the above basal diet The fifth group was used as control to which no supplement was added to the scorbutic diet The supplement was continued for two weeks when the animals showed steady and proportionate increase in body-weight The results of the biological assay are given in Table I

TABLE I

Group	Daily supplement	No of guineapigs for each test	Av wt on the day supplement started (in gm)	Av wt after 2 weeks of supplement (in gm)	Av gain
I	l-Ascorbic acid	2	296	232	+27
II	l-Ascorbyl laurate	3	287	315	+28
III	l-Ascorbyl palmitate	3	238	266 3	+28 5
IV	l-Ascorbyl stearate	3	310	335	+25
V	No supplement added to the basal diet	2	—	—	Died of scurvy

It will appear from the results in Table I that the anti-scorbutic action of 1-ascorbic acid is not significantly affected, by the esterification of the vitamin The biological utilisation of the fatty acid monoesters of 1-ascorbic acid being fairly comparable to that of 1-ascorbic acid, it may prove advantageous in certain vitamin preparations to use this fat soluble form of the vitamin

Our thanks are due to Dr S C Ray, for his kind interest and help in this work

M GOSWAMI
S MUKERJI
S N RAY

Dept of Applied Chemistry,
University College of Science and Technology,
Calcutta, 26-4-1948

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CHEMICAL INVESTIGATION OF THE BARK OF *PRUNUS ACUMINATA*

THE bark of *Prunus puddum* has been investigated in this laboratory and three crystalline compounds have been isolated from it, *e g*, (1) a flavone (Puddumetin), (2) isoflavone (Prunasetin), and (3) a flavanone (Sakuranetin)[1, 2, 3] In view of this interesting result, a systematic chemical investigation of the different species of *Prunus* available in India has been undertaken

A colourless crystalline compound (m p 250-51°) has been isolated from the bark of *Prunus acuminata*, collected from the district of Darjeeling

The air-dried powdered bark of *Prunus acuminata* was extracted with ether for 18 hours The dark reddish green oil, obtained after removing ether, was washed with petroleum ether (b p 40-60°) thrice when solid separated The solid was collected and repeatedly extracted with boiling rectified spirit and filtered The filtrate, on standing, deposited crystals which were further purified by repeated crystallization from glacial acetic acid (4 times) and ethyl acetate (6 times), colourless needles, m p 250-51° Yield 03 per cent It distilled at 190-200°/0 1 mm

The pure sample was dried over P_2O_5 in vacuum at 150-60° for 4 hours and was then analyzed (Found C, 82 52, H, 11 48 $C_{21}H_{36}O$ requires C, 82 89, H 11 84 per cent)

It forms beautiful needle shaped crystals under microscope It is insoluble in ether, water and caustic alkali, sparingly soluble in methyl and ethyl alcohols, but readily soluble in benzene and chloroform, warm ethyl acetate and warm glacial acetic acid

It does not respond to ferric chloride reaction, but responds to Liebermann-Burchard reaction,[4] Salkowski reaction[5] and Rosenheim test[6]

Further work is in progress

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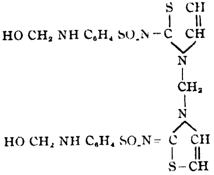
NEW SULPHA COMPOUND 6257 FOR CHOLERA INFECTION

IT has been recently noted by Bhatnagar[1] *et al* that 2 molecules of 2-p-amino-benzene sulphonamidothiazole and three molecules of formaldehyde react to form a compound $C_{21}H_{22}O_6N_6S_4$ (constitution not ascribed), effective against human Cholera infection Sulfathiazole is known to exert a bacteriostatic action against *V Cholerae* but this chemotherapeutic activity is lowered by the presence of a trace of p-aminobenzoic acid (0 05 μg per c c) In this respect "marfanil" (p-amino-methyl benzene sulphonamide) has been found by Basu *et al*[2] to be active in inhibiting the growth of *V Cholerae* even in presence of p-aminobenzoic acid at a concentration as high as 20 μg per c c

Work in this direction is being followed in this laboratory and it may be recorded here that the compound that has been recently described by Bhatnagar may also be produced by reacting sulfathiazole with hexamine The product is isolated in fine crystalline form melting with decomposition at 276-278°C From all its chemical characteristics and from the general behaviour of sulfathiazole (*c f*, Shepherd[3])

the structure of the compound, "6257" can be represented by the form (I)



(I)

Details of the work are being published elsewhere

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EVIDENCES OF PLEISTOCENE GLACIATION IN THE EASTERN HIMALAYAS

Work on Pleistocene glaciation in the Himalayas has been done by De Terra and Paterson,[1] who made a thorough study of the last Ice-Age in Kashmir, no work on glaciation in the eastern Himalayas has so far been done

While studying the soil development on the foothills and the sub-montane zone of Darjeeling and Bhutan Himalayas in the Western-Duars the author traced a magnificent 'boulder platform', about 24 miles from west to east between the rivers Chel and Daina, and about 5-7 miles from the base of the Himalayan front-ranges in the north to the flat monotonous plains in the south Being dissected by the major rivers Neora, Murti-Jaldhaka, Daina and other minor ones the platform stands as a series of tongues encroaching upon the plain Its elevation is about 1200 ft near the base of the Himalayas and is about a hundred feet at its southern extremity where it ends most abruptly as a line of cliff running west to east, often deeply cut by ravines, as between Neora and Jaldhaka West of Neora and, of Daina the boulder formation terminates in a series of low swells of clay, gravels and boulders, conspicuously distinct from the sandy plains beyond This extensive boulder bed was examined at 14-15 different places near deeply cut ravines and was found to be solely of boulders, large and small, all unassorted in a matrix of clay and silt, the soil samples showing a very high p c of clay (30-40 p c) together with a high proportion of sands and rock particles

Mallet[2] noticed these beds as an 'enormous recent boulder deposits' becoming finer and graduating into the ordinary alluvium of the plain to the south, typifying ordinary gravel-drifts or fluviatiles deposits But these beds do not get appreciably finer and certainly do not graduate, either topographically or texturally into the alluvial plain of the south, as is evidenced by the occurrence of quite large and small boulders stuck in a clayey matrix at the southern faces of the cliffs and in the predominance of boulders of considerable size, strewn beyond the southern cliff-edges, especially in the present stream beds This unassorted fabric of these deposits strongly simulates the 'tin fabric' texture and is undoubtedly of glacial origin

Godwin-Austin[3] noticed this gigantic boulder-clay formation with a 'very sudden termination of these gravels and clays in a more or less abrupt scarp running east and west' as also 'in a low scarp of sand and gravel' overlooking the dead level of the plain He also noticed like the present author large boulders, one was of 10 ft diameter, at the foot of the boulder-cliffs and on the stream beds far removed from the hills, 'requiring the existence of more than the ordinary transporting power of the moving water' The examination of rock samples from the entire depth of these beds and from all over the area reveals that the entire boulder platform is formed by gneissose and schistose rocks, evidently transported from the Bhutan and Darjeeling gneissic rock areas, more than 10 miles beyond the Daling slate and Tertiary sandstone belts which abut on the boulder beds here Absence of Daling slates and Tertiary sandstones is an important feature in these deposits This process of transport of such a prolific amount of gneissose rocks from such a long distance beyond the Daling front-ranges provides strong evidence in support of the glacial origin of these beds

The geomorphic evidences, are no less conspicuous In the Neora-Jaldhaka section there is a sharp break in the gradient of the platform where a series of isolated, elongated, knoblike hillock, of altitude 1100—1200 ft and running from west to east in an arc suddenly drops down to about 900 ft in their southern face, thus giving a terraced appearance These elongated knoblike hillocks, formed of the same unassorted boulders and clay, appeared to me as nothing but a series of 'drumlins', probably formed at the time of recession of a glacial lobe during the last Pleistocene Ice Age The general level of the

boulder bed, under a thick soil and jungle cover, is extremely hummocky, strongly resembling the marainic 'kettle and pond topography' of glacial origin In addition, paired 3-level terraces were noticed to have developed in all the large and small rivers and streams that run through the area

The geomorphic and the petrographic evidences adduced here strongly suggest that the 'boulder platform' represents the marginal depositions of a retreating glacial lobe from over the Himalayas and the 'drumlin-line' may be relegated to a pause in its slow recession and the paired terraces to a series of rejuvenation in the post-glacial drainage channels

Further work on the fabric of the till, petrology of rocks and geomorphology of the area is in progress which is expected to throw more light on the problem

The author is indebted to Prof S Roy of the Geology Department, Presidency College, Calcutta for his keen interest and help during the progress in the field work

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15 5-1948

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A PLEA FOR A SURVEY OF INDIAN FUNGI IN SEARCH OF ANTIBIOTICS

THE discovery, by a happy accident, of penicillin by Prof Fleming is one of the most outstanding events of recent times and has led, in the post-war period, scientists in all progressive countries embarking on a systematic hunt for antibacterial activity among different kinds of micro-organisms Without doubt penicillin still leads, although a number of promising substances of therapeutic value have already been discovered

In Government-sponsored investigations carried out in the United Kingdom, about 800 species of fungi of different groups have been tested for antibacterial activity by Wilkins and his collaborator [1] Similar tests have been carried out in the U S A by Robbins, Hervey and their associates[2] for about 1000 fungi, of which about 800 belong to the Basidiomycetes (wood-destroying higher fungi) In the course of a talk with Dr Robbins (Director of the New York Botanical Garden) in April 1948, the writer learnt that investigation of additional 1000 Basidiomycetes had been completed, and the results are now awaiting publication In Australia too, 200 mushrooms have been tested for antibacterial potency by Atkinson [3]

While so tremendous an amount of survey work is going on abroad, the position in India is distressingly poor, despite a rich and varied fungal flora that India has The writer, a solitary worker in this field in India, and working for the last four years at only one species of Basidiomycetes, *e g*, *Polystictus sanguineus*,[4] discovered a therapeutic substance of great value against, among others, an essentially tropical and widespread disease, namely, typhoid The work of purification of this crude substance and of isolation of the active principle is now being carried out with the active co-operation of American chemists India is a poor country, as regards both men and material, and can hardly be expected to come up to American or British levels of industry in this field, yet, we would urge the Government of India to make at least a modest but immediate beginning with this very important work of exploration of our Indian fungi and their antibiotic possibilities

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DATURA METEL L AND D FASTUOSA L

Datura Fastuosa L and *D Metel* L have been much misunderstood in the Indian Floras Too much importance has been given to the colour variation in their flowers Linnaeus himself did not attach much value to this character, for he included the Indian Daturas with white and purple flowers, with single, double and treble flowers in one broadly recognizable species [1] Clarke's interpretation of them and his synonymy have added to, rather than cleared this ambiguity of these species Many Indian authors have adopted more or less Clarke's species and varieties, but Clarke's *D Fastuosa* and *D Fastuosa* var *alba* are hardly worth separation from *D Metel* L, considering the nature of the leaves, indumentum, coloration of corollas and the number of corolline

teeth, as these points of difference have been found to be common to both, in a greater or less degree Clarke quotes *Botanical Magazine*, t 1440, (1809) under *D Metel* L and states that the corolla limb is 10 toothed But more than 5 teeth cannot be seen in this picture Probably the folds between the teeth have been mistaken for teeth

Linnaeus differentiated *D Fastuosa*[2] from *D Metel*[3] on the tuberculate nature of the thorns on the fruit After a thorough examination of the herbarium sheets at Sibpur and at the School of Tropical Medicine, Calcutta and the literature on *Datura*, the author has arrived at the conclusion that *D Metel* L being the oldest, should be the only valid species, and that *D Fastuosa* of Linnaeus and of other authors should be treated merely as a variety, namely, *D Metel* L var *Fastuosa* (L) Narayanaswami Comb Nov distinguished from the type in having bluntish, fewer, shorter and stouter spiny covering on the fruit and with both white and purple, as well as single, double and treble flowers These varietal characters should not be considered enough either for specific or varietal separation

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2 "Systema," ed 10, 932, 1759
3 "Species Plantarum", ed 1, 179, 1753

DISCHARGE MECHANISM IN AN OZONIZER

IN a previous communication[1] it was shown that the so-called "light effect"* as first observed by Joshi, is closely associated with the characteristic peculiarities of the ozonizer discharge and that to understand the former it is essential to first understand the latter

The characteristic peculiarities of the ozonizer discharge arise out of the fact that the electrodes which lead the currents in and out of the annular discharge space are made of insulators (glass) and not of conductors (metal) as in an ordinary discharge tube The essential features of the discharge, as are determinative of the "light effect", during each cycle of the applied exciting voltage (a c several kilovolts), are as follows

There is at first a discharge—an electrical breakdown (ionization) of the containing gas, this is followed by deposition of surface charges on the glass walls which stops the discharge, this is finally followed by a series of discharges due to the neutralization of the surface charges by a series of isolated sparks That the discharge phenomenon consists, in the main, of this sequence of events in each cycle was verified by recording the time variation of the discharge current with a cathode-ray oscillograph It was found, however, that the nature of the applied voltage (sinusoidal rise and fall) is such that complicating side effects are produced which, not infrequently, masked the essential sequence of events It was therefore thought that a clearer picture of the essential phenomena would be obtained if, instead of a c voltage, sharp voltage pulses, at intervals long compared with the duration of each pulse, were used for exciting the ozonizer In that case the surface charges produced as a result of the discharge by the voltage pulses would act in a field free space for a longer interval and show their effects clearly

The pulses were produced in the following way Radio frequency pulses as used for ionospheric exploration were picked up and rectified by using a suitable circuit The output voltage was made free from the radio-frequency by a filter and then applied to the two terminals of the ozonizer tube The dimension of the ozonizer and its other characteristics are given below

Radius of the inner electrode—4 mm
Radius of the outer electrode—10 mm
Length of the tube—15 cm
Magnitude of the voltage pulse—2500 volts
Circuit resistance—50,000 ohms

Typical oscillographic records of the discharge current are shown in Fig 1 It will be noticed that

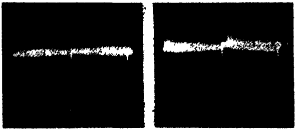

Fig 1
(a) (b)

in Fig 1(*a*) there are only the external voltage pulses at right angles to the time base This is the case when the pressure is high and there is no discharge When the pressure is gradually decreased, discharge suddenly starts and now two phenomena are observed. Firstly, the pulses appear to be lengthened and secondly a large number of closely packed pulses

* The "light effect" consists of a sharp decrease in the discharge current when an ozonizer tube in operation is flooded with light

appear between the externally applied voltage pulses [Fig 1(b)] The interpretation of these records according to the hypothesis of the discharge mechanism is simple The lengthening of the pulses is due to the superposition on the same of the ionization current produced by the electrical breakdown of the gas The ionization current is, however, transient because the electrons and ions produced are stopped by the glass walls as they are urged towards the same by the field of the applied voltage As a matter of fact they are deposited on the walls as surface charges The closely packed pulses are the discharge currents due to the neutralization of the surface charges by a series of isolated sparks This discharge, as expected, occurs in the interval between two applied voltage pulses when there is no external field It is also to be noted that the neutralizing pulses are produced in the opposite direction to the applied pulses This is as it should be, because the surface charges on the glass walls of the discharge tube produce field in the sense opposite to that of the applied voltage pulse

The discharge mechanism in an ozonizer based on the above hypothesis, as also the origin of the light effect are discussed in detail in a paper to be shortly published in the *Journal of the Indian Chemical Society*

We are grateful to Prof S K Mitra for his kind interest in the work

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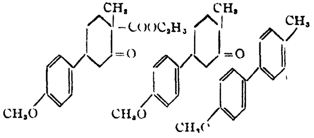
STUDY OF FRIEDEL CRAFT S REACTION INVOLVING UNSATURATED KETONES

WITH a view to study the nature of the linkage in the Friedel-Crafts reaction with $\alpha\beta$ Unsaturated Ketones[1] we have carried out the following experiments, as a result of which the synthesis of 5-(p-Methoxyphenyl)-2-methyl cyclohexanone has been achieved Anisole was condensed with Ethyl-2-methyl-Δ^5 cyclohexanone-2-carboxylate[2] in presence of anhydrous Aluminium chloride and dry HCl gas at —5°, to yield 5-(p-Methoxyphenyl)-2-Methyl-cyclohexanone-2-carboxylate, (I), b p 204°-205°/5 mm (Found C, 70 89, H, 7 98, $C_{17}H_{22}O_4$ requires C, 70 35, H, 7 58 per cent)



(I) (II) (III)

This Keto-ester (I) was then hydrolysed with aqueous caustic potash to yield (II), b p 165°—170°/4 mm (Found C, 76 41, H, 8 15, $C_{14}H_{18}O_2$ requires C, 77 06, H, 8 25 per cent) (Oxime m p 173°) The Ketone (II) was then reduced to the secondary alcohol by sodium and alcohol and the crude alcohol thus obtained was dehydrated with $KHSO_4$ to yield the Unsaturated compound, b p 135°/4 mm This on sulphur dehydrogenation at 220°—240° yielded a white solid compound (III) which on purification by crystallization from Petroleum ether (b p 60°—80°), high vacuum sublimation and further crystallizations from Petroleum ether (b p 60°—80°) melted at 110° This showed no depression in melting point when mixed with an authentic sample of 4-methoxy 4'-methyl-diphenyl m p 110°, prepared as follows

The Grignard complex of p-bromanisole was reacted with p-methyl-cyclohexanone to yield 4-(p-Methoxyphenyl)-1-methyl-cyclohex-4-ene, m p 72° (Found C, 83 24, H, 9 17, $C_{14}H_{18}O$ requires C, 83 16, H, 8 91 per cent), which on sulphur dehydrogeneration at 220°—240° furnished 4-methoxy-4'-methyl-diphenyl m p 110°[3] (Found C, 84 14, H, 7 49, $C_{14}H_{14}O$ requires C, 84 84, H, 7 67 per cent) The above series of experiments show clearly that linkage in the Friedel-Crafts reaction takes place normally in the para position

Our grateful thanks are due to Profs P C Mitter and D K Banerjee for their advice and encouragement during the course of this investigation Thanks are also due to the authorities of this College for giving the necessary facilities to one of us (H N K) to work in the Organic Research Laboratories

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SCIENCE AND CULTURE

A Monthly Journal of Natural and Cultural Sciences

Vol. 14 AUGUST 1948 No 2

DEPARTMENT OF SCIENTIFIC RESEARCH

RECENTLY an important statement has been issued through the A P I on the creation of a new Department of Scientific Research under the Prime Minister (See p 66) The announcement is brief, and raises many questions on the reorganisation of the existing machinery for scientific and industrial research and development through governmental and non-governmental agencies, as affected by it In some ways it implements *a portion* of the recommendations put forward by Prof A V Hill in his report on 'Scientific Research in India' He visited this country in 1943 following an invitation from the Indian Government, and the above report was based upon his visit to most of the research centres and discussion with scientists and leading scientific bodies

In order to view the recent pronouncement in its proper prospective it is necessary to review the activities of the Board of Scientific and Industrial Research (B S I R) since its establishment in 1940 and of the Council of SIR and its Governing Body which are functioning since 1942 At the time of publication of Hill's report, 'SCIENCE AND CULTURE' had published a series of articles in Vol X (1943), under the title, '*Scientific Education and Research in Relation to National Welfare*' The work of the C S I R upto the end of 1947 has recently been reviewed in an interesting report by Dr Bhatnagar, the Director of SIR, and in the present article it is our purpose also to discuss this report We understand that the latter was compiled for the use of a Reviewing Committee, but we have no information on the terms of reference to this Committee, nor of the recommendations, if any, of the Reviewing Committee on the report

In 1946, in the U S A , a committee of the President's Scientific Research Board, with Dr Steelman as Chairman, was requested by President Truman to report on the

"Federal research program, on non-Federal research development and training facilities, and on the interrelation of Federal and non-Federal research and development "

The Report under the title of 'Science and Public Policy' has recently been published in five booklets, and contains recommendations for co-ordinating federal program for greater efficiency and other recommendations for more effective use of national scientific resources Some parts of this report provides a valuable background for the assessment of the administrative policy of our C S I R There are other portions of the Steelman report on 'Manpower for Research' which will be of much value in estimating the recommendation of our Scientific Manpower Committee, and will be the object of a future article

The C S I R has been successively under the Departments of Industry, Supply, Planning and Research (now defunct), and after Independence, under the Ministry of Supply and Industries If we have understood correctly the new Government circular, it now goes directly under one of the Prime Minister's departments, *viz* , the newly created Department of Scientific Research The two other parallel bodies *viz* The Indian Council of Agricultural Research, and the Indian Research Fund Association (Medical) remains under the Ministries of Food and Agriculture, and of Public Health Each of them possess, like the C S I R , a registered Governing Body with power to distribute funds received by them from Government and from other sources for specific purposes, which include the maintenance of certain institutions, laboratories and the support of research through non-Governmental agencies The activities of the Council of Scientific and Industrial Research will be considered in detail here

Administration The activities of the Council are guided by two standing Advisory Boards, the Board of Scientific and Industrial Research and the Industrial Research Utilisation Committee, of which the former has more important functions of an advisory nature *viz* , to tender advice on proposals

(i) for instituting specific researches,

(2) from scientific institutions including universities and departments of such institutions, in the scientific study of problems affecting particular trade and industries,

(3) for the establishment of research institutes, studentships, scholarships and

(4) for specific studies and surveys of indigenous resources etc

The Board in discharging its responsibility for the "promotion, guidance and co-ordination of Scientific and Industrial Research in India, including the institution and financing of specific researches" is assisted by Research Committees, of which there are about 24 at present The research schemes from various scientific workers are scrutinized by the Research Committees and then forwarded with their recommendations to Board of S I R The recommendations of this Board are placed before a Governing Body, in which the administration of the Council of S I R is vested The Governing Body takes decisions on matters of policy, recommends grants for various research schemes (with or without modifications) The budget of the Council is subject to sanction by the Government of India through the Ministry of Finance One of the Research Committees 'on the Utilisation of Atomic Energy', was raised to the status of an independent *Board* directly under the Council of S I R, in 1947

Research Laboratories As a first step to the realisation of another of the important aims of the Board *viz*, 'the establishment, management, and maintenance of laboratories, workshops, institutes and organisations to further scientific and industrial research', the laboratories and the staff of the Industrial Research Bureau at the Government Test House, Alipore, were placed under the Director SIR who set up his physical and chemical laboratories for war work The were, since the entry of Japan into the war, removed to Delhi and housed in the buildings of the University With the establishment of the Council of SIR in March 1942, the Director in addition to his other duties became the Scientific Adviser to the Government of India Gradually with the expansion of the activities of the Council, the work and responsibilities of the Director increased correspondingly He has been relieved of direct charge of the Council Laboratories in Physics and Chemistry, which are now placed under two acting Directors The handicap under which these laboratories had to work during the war has been referred to in the report

"The initial equipment of these laboratories, originally planned for the Industrial Research Bureau as an experimental measure, was found to be very limited, and no substantial expansion could be effected during the war years, particularly since the Council took them over"

These laboratories have done some useful war work, and their future relation to the contemplated National Laboratories is yet to be determined During this time the desire to emulate other advanced countries by establishment of National Laboratories for applied research and standardisation grew insistent amongst scientists, and were taken up by the authorities Tentative proposals and schemes, drawn up at the instigation of the C S I R, for five such National laboratories and Institutes *viz* Chemical, Physical, Metallurgical Laboratories, Institute for Fuel Research, Glass and Ceramic Institute, were approved by the Government of India, and in 1944 a capital grant of one crore of rupees for the establishment of these institutes were made, to be taken up after the termination of the war

Evidently it was not realised then, what the post war conditions would be both in this country and abroad, with its shortage of capital goods, machinery and scientific apparatus, and even of building materials Australian scientists were able to anticipate the coming of the war, and to realise the necessity for equipping their country with meteorological instruments, so necessary for the successful starting of war industries They were able to obtain from the Government a grant of about £80,000/- with which the more important instruments were purchased and landed in Australia just before the war broke out Under a wise national Government the plants started for manufacture of war materials in that country have resulted in the establishment of several important iron and steel industries

Our decision to start such laboratories came at a very unfavourable moment Plans for these proposed laboratories, and also of the buildings to house them, have been drawn by the different Planning Committees entrusted with this work, and foundation stones of several of them have been laid nearly a year and half ago From this stage there has been a stand still in the progress of building construction till very recently Now the work of construction has been taken up in earnest in several places The appointment to the staff of the several laboratories were advertised nearly two years ago and some selections, including those of two of the Directors, were made about a year and half ago Most of the appointees have been requested to continue in their present jobs, pending the completion of the laboratories Probably it would have been wiser to start with less grandiose schemes The possibility of starting some of the laboratories in temporary accomodations, like those of the two Council laboratories in Delhi University buildings, could have been explored We understand that a suggestion was once mooted, that the National Physical Laboratories might be temporarily housed in some of the Government Laboratories in Calcutta, like the Alipore Test

House, the Telegraph Stores Laboratory, the Mathematical Instrument Department and in the Bengal Engineering College. Some of the considerations that were put forward against the selection of Calcutta as the head quarter of the NPL, now hold equally well in the case of Delhi. Since August 1947 Delhi has became a frontier town, from which whenever feasible important Government laboratories should be removed to more central places where scientific work could be carried out under quieter conditions.

We think that the Prime Minister has done a service to the country by discouraging, the tendency for migration to Delhi on the part of scientific laboratories and scientific surveys, in his address on the occasion of the Foundation stone laying ceremony of the National Institute of Sciences. We quite agree with him that the atmosphere of Delhi is *not* conducive to the growth of scientific research, and the mistakes committed by the establishment of certain national laboratories at Delhi should not be repeated.

Finance.—The main source of income of the C. S. I. R. is the Government grant, but there are other sources of income which may in future be augmented. In the Budget of the Council for 1947, the total receipts are estimated at Rs. 118.62 lakhs, which includes Rs. 39.39 lakhs, the unspent balance from last year, a lump sum grant of Rs. 57.36 lakhs (Rs. 30.00 lakhs non-recurring and Rs. 27.36 lakhs recurring). The principal items of recurring expenditure include Rs. 5.02 lakhs for the Council's laboratories, Rs. 9.42 lakhs for grant in aid to Universities and institutes for research, Rs. one lakh towards the expenditure of the various *ad hoc* Committees. For the various national laboratories provision has been made for a capital expenditure of Rs. 77.16 lakhs and of Rs. 5.51 lakhs for estimated recurring expenditure. It will be noticed that a total of Rs. 14.14 lakhs were spent for research in the Council's Delhi laboratories, and in non-Government institutions. Considering that there are 24 Research Committees under the Board of SIR, the expenditure of Rs. 9.42 lakhs on the latter account cannot be considered at all excessive. In fact, we would consider the amount as rather meagre, and it shows as nothing else does, that for some reason or other either, the Universities and other research institutes are not showing much enthusiasm in availing themselves of the grants offered by the C. S. I. R., or alternately the C. S. I. R. is unable to provide funds for them. In neither way, do the figures entitle the C. S. I. R. to much credit.

We have no knowledge as to how the Board of Research on Atomic Energy will function under the new Department of Scientific Research, and what plans have been formulated for the work to be undertaken under this Board, whether it will take the shape of a centralised Government station provided with large grants, undertaking work of a nature similar to that carried out in Harwell, England, or at Chalk River, Canada. Alternately it may be decided that the time is not yet ripe for the starting of a central Government station for utilisation of Atomic Energy, and for the present intensive work on the chemical, physical, metallurgical and engineering problems, associated with the construction of an Atomic Reactor, may be pursued by means of grant in aid to different university laboratories, research institutions and even to industrial concerns. Some duplications of grants for preliminary and pilot plant investigations may be encouraged at this stage. Depending on the nature of the work to be undertaken, the Board of Research on Atomic Energy may be constituted of a panel of whole time administrators with an advisory and planning council, or a Governing Body of experts, as it is now, which will distribute funds allocated to it by the Government for carrying on of research by different bodies.

Grant-in aid.—A certain amount of criticism has been evoked from recipients of grants from the C. S. I. R., at the delay that often elapses between the sending of a scheme to a Committee of Research and its final approval and sanction of grant by the Governing Body of the Council. It may take sometime two years, and by that time the interest in the scheme of its originator may have damped down, sometimes schemes finally sanctioned by the C. S. I. R., may be after two years' of passing through this or that body, have still to wait for indefinite periods, because the C. S. I. R. is unable to get round the Ministry of Finance. This difficulty has been felt rather acutely regarding schemes sent to the Atomic Research Committee and its successor the Board. It is reported that up till now the Board had no budget appropriation. If this is correct this should be soon remedied. In comparison to the importance of the work, the fund spent on Atomic Research has been very small so far. It has been estimated by Kowarski that for every dollar spent by U. S. A. on Atomic Research, Britain spends ten cents, and France spends just one cent. How much does India spend?

Some alternative method ought also to be found out for simplifying the procedure of submitting reports and accounts to the B. S. I. R. by individual recipients of grants. Two half yearly progress reports and one detailed application for renewal of grant, have to be sent each year. In addition periodic statements of account and inventories for apparatus have to be submitted. At present no grant is made to the institutions to cover the overhead expenditure for keeping of separate accounts of stock and for audit, and for maintenance charges. Estimates

of such over head expenses by different grant in aid bodies in the U S A have varied between 40 to 8 per cent of the total grant

The mechanism of distribution of research and development program of work amongst non-Governmental agencies by means of contracts, has been widely utilised in the U S A during the war and there are proposals for continuing this procedure in the post war period also Certain desirable modifications of the contractural procedure has been discussed in the Steelman Report

"The key to a contract for research is the performance clause In basic or fundamental research a form is needed that will combine the maximum of freedom for the scientist with the necessary financial safeguard O R S D developed a relatively simple provision to conduct studies and experimental investigations in connection witl a key problem and make a final report of its conclusions to a committee by a specified date The objective was stated in general terms and the clause was made deliberately flexible so that the contractor would not be hampered in his method of work "

Some of the conclusions which have been arrived in this Report are Contract, for research and development, should be utilised primarily for applied and development work and limited so far as possible to industrial research laboratories This method is not suitable for support of basic or fundamental research, as the basic concept underlying contract is inconsistent with the indeterminate character of basic or fundamental science Research grants are best for this kind of work They are of the nature of a gift made to individuals or institutions, whose competence has been demonstrated for an investigation, whose outcome cannot be known precisely in advance Under contracts it is more difficult, than it is under a research grant, to keep financial and progress report on a scale that will not interfere with the research itself The burden of reporting, and the work involved in computing direct and indirect research costs has been perhaps the only major complaint made in connection with the research program of the Office of Naval Research

"Most projects cannot be planned and executed in less than three to five years This means that investigators must be reasonably assured of support over this period before men, equipment and other facilities can be assembled Federal grants are however typically limited to one year, because the Government's operations are based on a fiscal year basis Congress has recognized the difficulties that this pattern creates in the research field, and has devised a method of reconciling the needs of research with the proper and necessary control over expenditure levels by the Congress *Thus funds obligated for research by the Office of Naval Research and the Atomic Energy Commission remain available for expenditure five years after the appropriation has been made* "

The above quotations show that the difficulties which have been felt in carrying out small scale grant in aid of research from the B S I R on annual renewal basis, have also been experienced in carrying out the very large volume of non-Governmental research undertaken during the war and post war periods in the U S A, and the methods which have been evolved to overcome such handicaps may with great advantage be studied and adopted, with necessary variations to suit the conditions prevalent in this country

The criticism of some of the drawbacks of the present system of grant in aids should not blind us from recognising the advantage which have accrued to Universities and institutions as are receiving such grants The following extract from Steelman's reports points out the advantages which have accrued to the Universities of U S A from Government contracts

"Most of the (University) departments report that the influence of Government contract is stimulating While some of the men who work on these contracts are lost to actual teaching, their participation in seminars, and the very presence of these men in the departments is stimulating to the other staff members and particularly to the junior staff As a matter of fact in many cases, research could not have been carried out except with the help of the Federal Government "

It is a matter of regret that so few of the Universities and research institutions are participating in the grant in aid research schemes There has been an understandable tendency in all countries to distribute the research grants to a small number of Universities and Institutes which are highly organized for such work But it has certain undesirable consequences It hampers the development of the smaller organisations by attracting the trained personnel to the larger institutions "Research cannot flourish today if it is confined to a limited number of centers It cannot enjoy the benefits of cross fertilization and intellectual interchange, unless conducted on a wide and open stage" Lastly for security reasons dispersal all over the country of research centers, as of production centers, is desirable

It is the responsibility of the C S I R as well as of the University Grants Committee to encourage the different Universities and other institutions to submit schemes for grant-in-aid research As we had pointed out already, both bodies have so far failed to do this, as is clearly indicated by the meagre sums so far provided

Organization of Scientific Research—According to the recent announcement, a Department for Scientific Research has been created under the Prime Minister, and Dr Bhatnagar has been appointed Secretary and Principal Executive Officer Further "this department will take over the work of the Board of Research on Atomic Energy and the Council of Scientific and Industrial Research The latter body although attached to the new department, will retain its unofficial character and continue to function as before" This announcement is characterised by vagueness and some inner inconsistency Will the Council of S I.R still retain its function as a registered body, authorized

to distribute funds allocated to it from Government or other sources or will it function as a purely advisory body? Further does the statement imply that the Atomic Research Board will suffer a peaceful extinction and its function be taken over by the newly created department?

How far have the recommendations contained in A V Hill's report been implemented in the present announcement? According to Hill it is "proposed that all the main six categories of scientific work affecting the welfare of the country (in addition to the pure academic research lying at the back of each of them) viz, (1) Medicine and Public Health (2) Agriculture and Animal Husbandry (3) Industry (4) Surveys and National Resources (5) Engineering (6) Defence Services, must be brought under a single Central Organisation, which will function under the Hon'ble Member (Minister) for Planning and Development" An essential part of Hill's proposals is that there will be six research boards, which will have the power to distribute grants for specific purposes in its own field, to be carried out by agreement by any institution in India The estimates for each Board will be scrutinised by a Joint Estimates Committee before submission to the Finance Department, and after they have been approved, each Board will be free to spend the funds at its disposal without further application or argument

We hope these unclarified points will be resolved in a further communique from the Government The decision to centralise research under the Prime Minister is to be welcomed, but further clarification will be necessary before we are in a position to understand the changes contemplated by the Government

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ORGANISATION AND WORK OF THE CAVENDISH LABORATORY*

LAWRENCE BRAGG

[The Cavendish Laboratory, Cambridge, is the foremost institution in the United Kingdom for higher training and research in Physics Founded in 1873, with a grant of £7,000 from the Duke of Devonshire, it had as its director (Cavendish Professor of Physics) such great Celebrities in Physics as, Clerk Maxwell (1773-1881), Lord Rayleigh (1881-1885), Sir J J Thomson (1885-1919), Lord Rutherford (1919-1938), and Sir L Bragg (1939-) For over three generations, the Laboratory has trained bands of physicists, many of whom have won undying fame as great discoverers, as teachers, leaders of thought, industrialists and occupying high places in Government service

The laboratory has grown in size and activity, along with the growth of Physics and its application to industries, communications, arts and crafts In the following article which we reproduce from NATURE, *the present director, Sir Lawrence Bragg, describes the present activities and organisation of the laboratory We have no doubt that the article will prove extremely interesting to readers of* SIENCE AND CULTURE *and especially to those who are connected with the organisation and management of research institutions in our country*—Ed SCIENCE AND CULTURE]

The Cavendish Laboratory is faced with problems which are common to most scientific laboratories in this post-war period, and arise from the great expansion in the numbers of undergraduate and graduate students Part of this increase is a temporary phenomenon Men are being released from the Forces who have missed the whole or part of their undergraduate time at the university, and are returning to swell the classes The increase in the first and second-year students at Cambridge is perhaps not as great as it is in other universities, because the undergraduate population is limited by college accommodation, in physics these classes at present are some 50 per cent greater than they were before the War The numbers in the final honours class, however, have almost trebled, because men returning from war-work for the most part join this class, which now has about a hundred and twenty students It will probably remain considerably higher than its pre-war level, because the recommendations of the Barlow Report reflect the need of the nation for more scientists, and *demand is creating a supply* The greatest increase of all is in the number of research students, and here the Laboratory is crowded to capacity, if not overcrowded Although all available places are used, the number of those who apply for admission as research students is three or four times as great as the number which can be accepted each

* From a course of three lectures delivered at the Royal Institution on March 4, 11 and 18, 1948 See *Nature*, April 24, 1948, *161*, p 62)

year More than a hundred and sixty researchers are now working in the Laboratory, of whom 110 are research students working for their Ph D degrees —between one-fifth and one-sixth of the total number registered for research degrees in Cambridge

This large increase implies a major change in the organisation of the Laboratory The old days when the head of the department could be in close contact with all his research students are a matter of the past There would appear to be a limit in organisations of all kinds to the number of men whom any one head can direct by close personal contact, this number being about six It applies in the direction of research as well, and devolving of responsibility is essential when numbers rise above this limit Even before the War, numbers of researchers in the larger laboratories were approaching the 6^2 level, and now they are in the 6^3 region In other words, the organisation of the research work involves splitting up the men into large groups under leaders, and these again into smaller groups, so that the head of the department is too removed from the researcher himself Except in a few special cases of work in which he is particularly interested, he cannot afford to spend that two or three-hour period every fortnight or so talking over his work with the individual, which is essential for real direction

The major groups in the Cavendish Laboratory are nuclear, radio, low-temperature physics, crystallography, metal physics and mathematical physics, with some minor groupings It may be interesting to give some account of the extent to which these groups are independent, and of the common ground on which they meet The great foe of research is administrative responsibility A nice adjustment has to be made between giving the heads of groups as much freedom as possible to make their plans for using their facilities to the best advantage, and at the same time relieving them of the more tiresome and mechanical details of administration which can be properly centralized In our organisation each group has its own allocation of the budget for the year, and its own order-book, so that apparatus and supplies can be bought within that budget , each has its own staff of assistants and its workshop , it has its own secretary for clerical work , further, each group runs its own colloquium, where scientific papers from other laboratories are discussed and the researchers give reports of their progress The days are past when most researches in a department were on closely related lines and a joint colloquium was possible A colloquium in one group or another is now an almost daily event, and no individual can spare the time to go to them all Common touch is kept up by the fortnightly meetings of the Cavendish Physical Society, where the heads of the groups give an account of the work going on in their sections, and distinguished visitors speak, and by more informal meetings of the leading researchers, such as the little club which was founded by Kapitza when he was head of the Mond Laboratory

The administrative burden of the teaching staff has been much lightened by the appointment by the University of a secretary to the Laboratory This officer has in his charge finance, appointments of assistant staff and rates of pay, the formal work concerned with admissions, structural alterations and upkeep of the buildings, preparation of agenda for meetings, and other matters of this kind

A *main workshop* serves all sections of the Laboratory, where work requiring special tools and skills is carried out , glass-blowing is also centralized There is also a separate central workshop where research students can use the machine tools, where the young assistants are trained, and where repairs to class-apparatus are carried out In addition, two special centres deserve mention It has been found convenient to have a 'special techniques' workshop where the most highly skilled and delicate work of especial kinds is carried out, and to place this workshop in charge of a member of the staff It is largely concerned with the construction and sealing of Geiger counters, and the purification of the gases with which they are filled Special thermionic devices are made there, and evacuated, baked and sealed It manufactures delicate metal parts by a photographic technique, such as supports for thin-walled windows, makes special metal-to-glass or metal-to-silica joints, and has apparatus for preparing thin metal films by evaporation The other centre, also in charge of a member of the staff, constructs and maintains electronic equipment of all kinds, such as decimal scalars and multiple coincidence circuits, or pulse and D C amplifiers for nuclear work The capital value of the electronic equipment of this kind approaches five figures, and it is a saving of time and money to place it in charge of an expert

The largest group in the Laboratory is the nuclear physics groups, under Prof O R Frisch and Mr E S Shire, with some forty researchers The Cambridge equipment includes the one-million and two-million volt sets in the high-tension laboratory, and a cyclotron with 37 in pole-pieces A five million volt Van de Graaff generator is being built for the Laboratory by the English Electric Company, and it is hoped to get it running by the end of 1948 The maintenance of these large and complex units introduces problems of a new scale in a physics lobaratory It creates the need for a new type of staff member, the 'technical officer' He must be a trained physicist, in general a university graduate, but a man who has the engineer's outlook and who is interested in the construction and functioning of the apparatus rather than in the research which is done with it

The radio group represents the continuation in the Laboratory of the work which Sir Edward Appleton started when he occupied the Jacksonian chair at Cambridge, it is now under the direction of Mr J A Ratcliffe It has field stations as well as its section of the main Laboratory The work on propagation is mainly concerned with the longer wave-lengths which are reflected below the *E* layer Another section is making measurements of the waves in the metre wave-length region coming from the sun, recording their intensity and propagation and estimating the size of the source from which they come by a method analogous to Michelson's method of measuring the angular diameter of a star

The Mond Laboratory is now under the direction of Dr D Shoenberg, its former head, Dr J F Allen, having been recently appointed to St Andrews A main interest is the properties of superconductors, in particular the penetration of magnetic fields into superconductors It has equipment for the magnetic method of cooling. Liquid helium is at present made by Kapitza's expansion machine, but a new machine of greater capacity and more orthodox type is under construction

In crystallography, under Dr W H Taylor, the arrangement of atoms in minerals, alloys, organic compounds and proteins is being studied The section studying proteins under Dr M F Perutz and J C Kendrew has this year been accorded the backing of the Medical Research Council The elucidation of the structure of such enormous and complex molecules is the most ambitious problem as yet tackled by X-ray analysis, and success would cast a flood of light on the structure of living matter

The metal physics section, under Dr E Orowan, is concerned with problems of slip and plasticity, fracture, crystal growth, and metallic phenomena in general investigated by physical methods

The Laboratory houses an electron microscope service which is used by all departments of the University It provides hospitality for several researchers from other departments Particularly welcome guests are the mathematical physicists, including the Plummer professor, D R Hartree, who have rooms in the Laboratory

It may be of interest to assess in round figures the cost of research in the Cavendish Laboratory The figures must be approximate, since many of the services are common to teaching and research As an example, in the following estimate the time of the University staff is regarded as divided equally between teaching and research, and its cost apportioned accordingly Making similar adjustments for administrations, assistant staff, stores and apparatus (almost entirely research) and so forth, the total expenditure on research in the Laboratory (including the Mond) was just short of £60,000 in 1946-47, of which £10,000 came from outside sources To this must be added a sum to represent the rental of the buildings, which does not appear in the estimates In estimating the cost per research student, the abnormal position of nuclear research must be taken into account Not only are the running expenses above the average, but also units such as the cyclotron represent a large outlay of capital, and special grants are made by the Department of Scientific and Industrial Research to meet needs which the University cannot finance from its own resources Such requirements vary very greatly from year to year, and I have therefore only included a sum for nuclear research which corresponds to the expenditure per researcher in other branches of physics, and which roughly represents the contribution which the University itself makes towards the cost of the nuclear research On this basis, the cost per research student is £400 a year If to this is added £350 to represent the average maintenance grant of junior and senior workers, the total cost to the State of maintaining a research worker in the Cavendish Laboratory is £750 a year

PLANT QUARANTINE*

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Principles of Plant Quarantine

PLANT diseases and insect pests have often been limiting factors in crop production Not only that, cases are on record where particular diseases or pests have solely been responsible for abandonment of production or virtual extermination of some important crops from certain parts of the world Such depredations have been caused by fungal or bacterial organisms that travelled from one part to the other of the same country or even from a different continent before they were able to start their nefarious activities of crop destruction in the new habitats And plant quarantine has been one of the recent means employed in combating as well as preventing such depredations especially in such cases where the disease pathogens or the insect pests must spread to new environment in a foreign country or to another part of the same country before they could attack their susceptible hosts

Plant Quarantine Defined

The most accepted and comprehensive definition of plant quarantine has been the one given by the National Plant Board of U S A in 1932 which runs as follows

"A quarantine is a restriction, imposed by duly constituted authorities, whereby the production, movement or existence of plants and plant products animals and animal products, or any other article or material, or the normal activity of persons, is brought under regulation, in order that the introduction or spread of a pest may be prevented or limited, or in order that a pest already introduced may be controlled or eradicated, thereby reducing or avoiding losses that would otherwise occur through damage done by the pest or through a continuing cost of control measures "

The above definition comprises both plant and animal quarantines, and the same set of basic principles hold good for either case This article will, however, confine its attention to quarantine activities in relation to plants and plant products

* Much of the information contained in this article is gathered from the publications of the various State Agricultural Experiment Stations, Bureau of Plant Industry and especially of the Bureau of Entomology and Plant Quarantine, U S Department of Agriculture

Most of the examples cited have, of necessity, been from the field of American agriculture, U S A having so far the most elaborate Plant Quarantine set-up, fuller information was available from that source

Imposes Restrictions on Human Activities

A further analysis of the above definition will show that quarantine is a legal restriction or restrictions imposed and enforced by the government of a country on the movement of plants, plant parts, or unprocessed plant products with the aim thereby of preventing or delaying the establishment of new diseases or pests in new areas, where they are not known to have occurred before, or if already established within recent years in a new situation to effect or aid in the extermination or eradication of such pests or diseases

Plant quarantine therefore shows at least one difference from the customary disease and pests control operations, which are voluntarily carried by farmers on their own initiative for achieving more monetary gains by cutting off or putting down losses from diseases or pests , the farmer is at the same time free, if he so chooses, to allow the pest or disease to run rampant over his crops But plant quarantine activities are regulated and enforced by government agencies of a country and are to be observed, when and where in force, as compulsory measures by farmers, nurserymen, orchardists, florists, or anyone who deals, handles in any way plants, or plant parts, or plant products in question for common benefit of the entire community over a prescribed area The jurisdiction of such an area may be limited to that of an union, a police station, a district, a province, or it might comprise the whole country Quarantine activities have therefore the aim of serving the greater interest of a nation at large as a whole than one of benefiting only a few or a particular interest

This restriction or prohibition in movement may involve only a single plant or only a certain part of a plant or its yield throughout all the months of a period of years or only during a particular season of the year depending upon the nature of the pests and diseases, which the plant or plant parts in question carry or are susceptible to infection and attack Such plant or plant parts are not allowed to move out of the quarantined area into uninfested territories in the reasonable apprehension that the diseases or pests might be carried to and subsequently established there along with the plants In the causation of a disease two organisms are involved the plant as a host and the insect, fungus or bacterium as a parasite. Similar

restrictions therefore, it goes without saying, are operative on the movement of living plant pathogens and pests

In the case of foreign plants, plant parts, etc, plant pathogenic organisms, and pests, quarantine operations are directed against the entry of such diseased or infested materials as well as the live pathogens and pests into the territory of the country enacting quarantine laws

JUSTIFICATION FOR SUCH RESTRICTIONS

Now, the question comes up whether such restrictions on the rights, liberties, and activities of the people of a democratic society are justifiable The operation of a quarantine act may snatch away the liberties of connoisseur of orchids of collecting orchid bulbs from all corners of the world because such bulbs might harbor inside them germs of diseases or pests, which when introduced might destroy the cultivation of indigenous orchids or establish on alternate host species, which use cultivated as major crops and thus cause in the long run, much economic loss More seriously, it may restrict the operation of a bonafide trader, who wishes to import, because of cheaper rate, plant commodities from certain localities known to harbor a pest or disease, and sell it for higher profit in another place Unless restricted by quarantine, such operations will in all probability bring the disease or the pest too into the new territory Sometimes the imposition of a quarantine against the movement out of a restricted area of a particular crop in view of its infestation by a pest or disease might cause loss to a group of growers because of the curtailment of the usual outside markets, where such produces were sold in previous years The consumers as well might be inconvenienced due to their inability to buy such commodities at the price and from the sources they were so long used to

But if such quarantines are efficatious as they have often proved to be, and as will be evident hereinafter, in excluding destructive pests and diseases, the ultimate effect will be more abundant production or production of better quality of yield with the consequent lowering of prices due to more and better production Such produce will soon sell at cheaper price benefiting the consumer who will now be compensated by the quality and the price of his purchase for his undergoing inconvenience in the past, while farmers will be awarded with the assurance of freedom from fear of sudden outbreaks of such pests or diseases, reaping a good harvest and saving by way of less operational cost of sprays, etc, to protect his crops from the clutches of such exotic pests and diseases.

Thus temporary inconveniences or monetary losses caused by quarantine activities are repaid many fold in premium in the long run in the form of increased production, better quality of the produce, low cost of production and in the continued assurance against suddenly becoming a prey to a newly introduced pest or disease

To bring this point more firmly to home a few well known cases will be mentioned hereinbelow to prove conclusively how devastative the introduction of foreign diseases or pests may prove to be in a country but which, earlier enactment and enforcement of quarantine might probably have altogether prevented such introductions and thus avoided the devastative sequence on the crops in question

REALITY OF DISEASE AND PEST INTRODUCTIONS AND ESTABLISHMENT

It may be argued that introduction of a foreign pest or pathogen may not necessarily result in the establishment of the pest or disease But nobody can definitely say it will not establish itself in the new territory when it is introduced The usual scientific method would have been to bring in the pest or pathogen in question, let it loose and allow it to feed or grow as it may in fields and orchards for a reasonable length of time, and then ascertain its destructive capacity from actual performances But it is a highly risky step and none with any sense of judgement will ever advocate such trials So the only way to ascertain its probable performance, if introduced, will be from the comparative study of its habits, life history, and activities in its natural home and then drawing reasonable conclusions as to its probable performance if ever it gets introduced But even such justifiable inferences as to its behavior in a new territory has not always proved to be true Many cases are on record where it has performed differently Powdery scab of potato (*Spongospora subterranea*) so serious elsewhere that its introduction into the U S A was viewed with great apprehension until it was found already established and usually unimportant But others like chestnut blight (*Endothia parasitica*), citrus canker (*Pseudomonas citri*) not much feared in their natural homes in the Far East, have proved immensely devastative when introduced into the United States While cases like white-pine blister rust (*Cronartium ribicola*) and Dutch elm disease (*Ceratostomella ulmi*) known to be destructive in their natural European habits are performing faithfully their missions in North America since their introduction *Botrytis* blight disease introduced into Florida on consignments of castor oil seeds from India during World War I virtually affected the subsequent cultivation of castor beans in that State Asparagus rust, like chestnut blight or citrus canker, little cared for in its natural home in Europe, is another case in the varying field of biology which created greater havoc

in the first few years after its introduction over the whole of the United States and virtually destroyed the asparagus industry , but soon through breeding and propagation of resistant varieties further losses were checked and is at present of little economic significance in asparagus cultivation Other introduced diseases of economic significance in the United States have been potato wart (*Synchytrium endobioticum*), popular canker (*Dothichiza populea*), alfalfa leaf rust (*Uromyces striatus*), alfalfa leaf spot (*Pyrenopeziza medicaginis*), bean anthracnose (*Colletotrichum lindemuthianum*), blue mold or downy mildew of tobacco (*Peronospora tabacina*), black-leg of crucifers (*Phoma lingam*), red stele disease of strawberry (*Phytophthora fragariae*), flag smut of wheat (*Urocystis tritici*), bacterial ring rot of potato (*Phytomonas sepedonica*),

The above, though not a complete list, have just been the introductions since 1900, and many of them after the enactment and enforcement of quarantines As late as 1941 and 1943 potato parasites, *viz* , golden nematode (*Heterodera rostochiensis*) of potato in Long Island,, New York State, and potato rot nematode (*Ditylenchus destructor*) at Aberdeen, Idaho, have respectively been found established over limited areas at those places Both of these two nematodes have long been known to be indigenous to certain European countries, but how they could get over and establish at such isolated localities is not as yet precisely known

It has been estimated by workers of the United States Department of Agriculture that about two hundred of the known diseases of that country have been introduced at one time or another from some one or another of the foreign countries

It shall now be apparent that, if in spite of the elaborate arrangement of enforcement of quarantine a score of diseases could get in and establish foot-hold, what would have happened had there been no quarantines Control, extermination and eradication, even when possible but often not possible, of a single disease, as will be seen later, is expensive enough So prevention of introductions, as far as possible, through quarantine actions is the only best way available

In the field of entomology some of the noted introduction of pests, responsible for losses of great magnitude, may be enumerated as follows cottony cushion scale (*Icerya purchasi*), Japanese beetle (*Popillia japonica*), alfalfa weevil (*Hypera postical*), European corn-borer (*Pyrausta nubilalis*), the gypsy moth (*Porthetria dispar*), the brown-tail moth (*Euproctis chrysorrhoea*), the Mexican fruitfly (*Anastrepha ludens*), the oriental fruit moth (*Grapholitha molesta*), the satin moth (*Stilpontia salicis*), the pink boll-worm (*Plectinophora gossypiella*), the cotton boll-weevil (*Anthonomus grandis*), white fringed bettle (*Naupactus leucoloma*)

At the same time records of the performance of indigenous North American diseases and pests have not been altogether unimpeachable upon the agriculture of some of the European States Phylloxera of vine (*Vitis vinifera*), almost completely wiped away vine cultivation in France and jeopardized the wine industry , downy mildew (*Plasmopara viticola*) and black rot (*Guignardia bidwellii*)—two diseases of grape vines of minor significance as Phylloxera in the United States—followed Phylloxera pest to add to the damage already caused there by Phylloxera in subsequent years Wooly aphid (*Eriosoma lanigerum*), distributed from its original home in Eastern U S A , has been of considerable concern to the orchardists of the different continents

Many more await to Enter

The above lists of pests and diseases does not in itself give a true picture of the whole situation They were only the few lucky ones that enter and establish in that country But there are many hundreds more of these pests and diseases that are seeking every opportunity to enter into the mainland by way of imported seeds, nursery stocks, agricultural commodities, packing materials, etc Many of these awaiting their opportunity to get in have behind them a record of unprecedented damage in their countries of origin , many others, as could be seen from comparative study of biological and ecological conditions of their natural habitats, will likely to prove more destructive than they had been in their natural habitats, while there are many among these whose probable performance in a new territory cannot be definitely predicted Even if their performance be no worse than in their countries of origin, their introduction will prove burdensome to the farmers Because of the special and competitive nature of agricultural and a strict grading of produce, a simple pimple on an apple will degrade the quality of the produce and therefore will bring the grower much less in sale value or even may run him into losses

The annual reports of the United States Department of Agriculture for the fiscal year of 1946 give the following figures of interception of prohibited and restricted plant materials trying to get into that country from foreign countries, "in baggages, 73,214 , in cargo, 410 , in mail, 3,648 , in ships' quarters, 9,031 , in stores, 11,498 , total 97,801 " While actual interception figures for insects and diseases for the same year are given as follows "In materials offered for entry for consumption, 25,209 insects and 13,949 diseases , in materials offered for entry for propogation, 10,630 insects and 2,737 diseases , in materials not offered for entry, such as in-transit shipments and materials in ships' stores, stewards' quarters, etc , 3,854 insects and 1,924 diseases , total 39,639 insects and 18,610 diseases " (These figures represent numbers of individual inter-

ceptions and the same pests or pathogens may be involved over and over again But the number of individual species of pests or pathogens run into several hundreds)

Introduced Pests and Diseases Devastative

It is often difficult, well-nigh impossible, to estimate accurately the loss in terms of money value due to a particular disease or pest introduced But it will be easily evident that each new disease in a crop will put additional burdens upon the farmers through increased cost of control measures to keep down damage, the percentage of loss suffered despite control measures applied, the deterioration in the quality of the produce, etc This extra cost of safeguarding the crops will continue for many years till the introduced disease or pest can, if ever, be completely eradicated or new resistant varieties are obtained

Attention will now be paid to a few cases about which more detailed information is available The first example that spontaneously crops up is the case of chestnut blight, a disease indigenous to China and Japan This disease was first noticed in the New Zoological Park in 1904, and by 1908 the disease spread with alarming rapidity over hundreds of miles from Massachusetts to Virginia, and by 1914 the process of spread was completed by which time it wiped out all stands of chestunt trees—trees which used to supply very valuable timber with the additional attributes of producers of delicious nuts and valued further as nice shade trees The loss incurred through the virtual elimination of eastern chestnut stands has been computed at above 33 crores of rupees (=$100 million dollars), to this must be added the several millions of dollars spent unsuccessfully in efforts to combat the scourge by way of direct control measures and the money that is still being spent in research for breeding resistant varieties

White-pine blister rust attacking white and other five-needled pines has been one of European scourges introduced into Eastern United States of America in nursery stocks imported from Germany in several shipments between 1898 and 1908 And during the course of the next few years, it spread over the pine areas covered by the New England States in the North, Minnesota in the West, and Virginia in the South The disease similarly got introduced in Vancouver, British Columbia, in white-pine seedlings from France in 1910 By 1921 it spread down to Washington, and by 1930 into Oregon, North California, Idaho, and partly into the Montana State

Vigorous programme of the eradication of currants and gooseberries (*Ribes nigrum, R petiolare, R inermis*, etc) which serve as alternate hosts for the white-pine blister rust fungus and which are essential for the survival as well as spread into pine stands of this blister rust Since 1916, more than 15 crores of rupees ($45 million) have already ben spent for the eradication campaign with appreciable results , and how many millions more will have to be spent before the scourge can be completely suppressed nobody can guess To these figures must be added the loss of the potential value of the millions of once promising seedlings, which would, in due course, have turned into valuable timber as well as the mature plants killed by the blister rust The blister rust is unusually destructive as it can attack with equal ease, seedling as well as mature stands of white-pines

Citrus Canker (*Bacterium citri*) was introduced into Monticello, Florida, towards the end of 1912, in nursery stocks of *Poncirus trifoliate* imported from Japan Soon the canker pathogen established into commercial citrus orchards and spread widely over wide areas of the Gulf Coast, *viz* , Alabama, Georgia, Louisiana, Mississippi, South Carolina and Texas Control and eradication programme in a gigantic scale was set into force in 1915 and continued till June 1944, before the last trace of the bacterial canker was completely eradicated from the entire area This has been one of the very few heartening examples where complete eradication of a disease over such a vast area has ever been possible To achieve this has been a costly affair on the purse of the States and Federal (United States) exchequers Over a total of 4 crores of rupees ($13 million) have had to be spent and several times that sum lost in the value of 19,500,000 commercial nursery and orchard citrus trees that had to be destroyed as well as nearly 28,000,000 non-commercial citrus host trees had to be wiped out before the desired end was reached

Pink bollworm (*Pectinophora gossypiella*), which claims the notoriety of being one of the six most destructive insect pests of the world, is one example in the field of entomology where eradication campaign against an intruder has been almost as equally successful as in the case of citrus canker just mentioned The pest was first observed in the United States late in 1917 at Hearve and Beaumont in the State of Texas, in the vicinity of oil mills that received cotton seeds for crushing from Mexico The infestation was found spread over a radius of twelve to fifteen miles By very prompt and intensive actions by the Texas and the United States Departments of Agriculture, with a total appropriation of more than 30 lakhs of rupees (=$900,000) by the State and the Federal Governments, that the pest was completely eradicated before the 1918 growing season, which showed not a single pink bollworm

Localized and isolated pink bollworm infected areas were later discovered in Louisiana, New Mexico,

Arizona and Western Texas Scouting has eradicated the pest completely from Louisiana and several spots of the other States, but localized areas of infestation still exist under quarantine cordon in Western Texas, and parts of Arizona and New Mexico

Cotton-boll weevil (*Anthonomus grandis*) has probably caused the heaviest damage to American agriculture among all of the introduced or indigenous pests The cotton-boll weevil, a native of Central America, entered into the United States mainland through Mexico, and was first seen in the Southern end of Texas in 1892 Since then it spread north and eastward at an average rate of more than 20,000 square miles of new area in each of the first 35 years, and now occupies practically all the principal cotton-growing areas of the United States Reliable estimates fix the current annual loss at 20 to 40% of normal production or, in other words, 3,000,000 to 5,000,000 bales of cotton representing a sum of 33 to 66 crores of rupees (= $100 to 200 million) computed at pre-war price index in the value of cotton lint lost The total loss up to date inflicted upon the cotton interests of the United States by this pest alone can be conservatively calculated to be over $5,000,000,000 (or 2000 crores in Indian money)

Besides such direct colossal losses, there have been additional losses due to the abondonment of cotton cultivation, depreciation of land values, closing down of cotton gins and oil mills, interruption of railroad and merchandise business, etc One authority estimates that each American pays 30 rupees a year more for his cotton goods than he would otherwise have paid if there were no introduction of this exotic cotton-boll pest

Control and eradication campaigns have always been costly Potato wart (*Synchytrium endobioticum*) was carried into the United States in 1911 and 1912, just before the Federal quarantine came into operation, in several shiploads of potatoes imported from Europe The wart disease soon established its hold over limited areas in the contiguous States of Pennsylvania, Maryland and West Virginia Since its detection, about 20 lakhs of rupees ($0 6 million dollars) have been spent to keep it from spreading and in eradicating it where possible

The recent discoveries of the establishment of golden nematode of potato (*Heterodera rostochiensis*) in Naussau County, Long Island, New York State, in 1941, and of potato rot nematode (*Ditylenchus destructor*) at Aberdeen, Idaho, in 1943, are since causing expenditure of several hundred thousands of dollars for eradication and control campaigns which are yet to prove effective

The picture of havoc caused by introduced pests and diseases would not be complete without reference to the Phylloxera of vines To make a long story short, Phylloxera (*P vaitatrix*), since its introduction into France from America about the year 1880, had wiped out within the next 25 years, 2,500,000 acres of prized vineyards, and at its worst caused an annual loss in wine production of the value of 150,000,000 francs over a period of several years

Some Viewpoints on Quarantine

We have seen hereinbefore how much descructive the introduction of foreign pests and diseases may prove to be But still the enactment of quarantines and their enforcement in early 1910's did not pass, as possible many other beneficial public laws, without enough of unfavourable criticisms Many of those criticisms have by now proved to have been based not on biological facts as they have expressed themselves to be in the investigations in the decades following, some were based on mis-apprehension on the too much possibility of hampering normal trade activities out weighing the possible benefit resulting from quarantine enforcement, many others have now no more value, except possibly a historical one, to show the rise and growth and development of human thoughts in the adoption and application of legislative measures in controlling, or preventing introduction from foreign countries, or against spread from one part of the same country to another of plant diseases and pests Even workers in plant sciences questioned in those days the biological soundness of quarantine principles maintaining that diseases and pests are constantly under urge of powerful natural forces of dispersal to maintain their existence and wondered if this biological tendency of dispersal could at all be prevented or appreciably delayed with reasonable amount of human efforts That they can be delayed by human efforts will be proved from several cases on record where pests or diseases, whose natural rate of spread have been curtailed and ultimately eliminated through eradication programme That a few diseases and pests have avoided quarantine measures, got in and later established themselves are known and have been mentioned earlier, but just pause a while to think what a calamity will befall if only one pest or disease in a thousand or even ten thousand that knock for entrance but are intercepted by quarantine workers at the ports, got established into the mainland each year All of these prospective intruders may not have the potentiality of a chestnut blight or a cotton-boll weevil but only a very few of that type will be too much for any country of the world to cope with

Another criticism that was and is often heard, and is still in the minds of many others, is that the power of plant quarantine laws in the hands of interested persons or politicians might be used in excluding commercial plant commodities from another

country, or even from another province of the same country in the case of inter-provincial quarantine—thereby benefiting the local producers but at the same time causing hardship to many more consumer public, who are now to pay more for home grown articles Fortunately however, no country has so far passed any quarantine except on the imperative necessity on biological grounds to secure any trade advantage under the disguise of quarantine But the possibility of such dishonest application remains The only deterrent being that the country thus discriminated will not take it lying down and will try to retaliate similarly

Guard Against Misuse Biological Principles Formulated

To guard against any misuse on flimsy grounds or discriminative application against any part of the same or another country on political grounds the National Plant Board of the United States has in 1932 formulated a fine set of fundamental prerequisites—worthy of being followed by all countries—based strictly on biological and economical principles, which must be fulfilled by each and every case before a particular quarantine should be enacted They are as follows

1 "The pest (or disease) concerned must be of such a nature as to offer actual or expected threat to substantial interests,

2 "The proposed quarantine must represent a necessary or desirable measure for which no other substitute, involving less interference with normal activities, is available,

3 "The object of the quarantine, either for preventing introduction or for limiting spread, must be reasonable of expectation,

4 "The economic gains expected must outweigh the cost of administration and the interference with normal activities"

The above are self-explanatory and need little further elucidation They state that no quarantine should be invoked unless the pest or disease presents real or potential threat not to a few but many substantial interests, that if some other measure is known which is presumably as effective but which is less costly or less interfering with normal activities or business then such a measure should be adopted and not quarantine That quarantine should not be applied in cases where the objective cannot be reasonably expected to be achieved so far as can be judged about the actual or probable behaviours of the disease or pest in question Quarantine operation, to be worthy of enforcement, should cost less than the economic losses the disease or pest might occasion

KOSI—THE PROBLEM RIVER

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KAUSHIKI—popularly known as Kosi has shot up in the picture One of the highest dams ever constructed is likely to be raised across it and the poverty stricken Northern Bihar will be converted into a land of plenty We intend to present before our readers a picture of the story in the following lines

The Kosi is the third largest of the Himalayan rivers The Sun Kosi flowing from the foot hills of Gourisankar, the Arun emerging from the snow fields of the Everest and the Tamur coming from the slopes of the Kanchanjangha combine near Barahakshetra and the resultant stream assumes the name of Kaushiki—popularly known as Kosi It finally emerges on the plains in Bihar near Chatra and flows south to meet the Ganges in a number of split channels The total length of the river is 369 miles of which the plains tract is 109 miles

The Problem

Like the Mahanadi and the Damodar, the Kosi too has been causing devastating floods year after year As in the cases of the Damodar and the Mahanadi, the catchment of the Kosi also comprises a hilly tract and a plain tract The upper catchment in the Himalayan slopes in Nepal is almost unpopulated and therefore there is no damage in this part due to floods etc But the lower catchment in the plains in Bihar is comparatively densely populated (800 people to the square mile) and here the effects of the floods and the attendant maladies are felt most seriously We quote below a portion of the account prepared by the Kosi Sufferers' Conference as presented by Sri Harinatha Misra, M A, M L A, to give a rough idea of the extent of havoc caused by the Kosi —

"We do not know whether or not the Government or any other body have cared to collect relevant

data about the havoc wrought by the Kosi in its present belt in various spheres If they have not, as we think is the case, that only shows their indifference and callousness to the miseries of the people For, knowledge of the magnitude of a problem is clearly the essential preliminary to the devising of ways and means of meeting it and solving it Some three years back, our Committee, however, carried out investigations into these fields and, on the basis of random sampling, arrived at certain results Presently we shall give the same But lest we may be misunderstood, a word of caution is necessary We have had to work under many formidable handicaps, financial difficulties not being the least among them, and it is only natural that our conclusions may not be without mistake With this proviso, we beg to place our conclusions as given below —

(1) *Financial loss*

'The following shows the price of produces every year before the advent of the Kosi, in its present belt

Crops	Area in sq miles	Area in acres	Yield in maunds	Price pre-war	Price present
Paddy	1,800	11,52,000	1,15,20,000	2,30,40,000 @ Rs 2/- per maund	69,120,000 @ Rs 6/- per maund
Bhadai & Rabi	600	3,84,000	57,60,000	1,72,80,000 @ Rs 3/- per maund	5,18,40,000 @ Rs 9/ per maund
Money crop	150	96,000		96,00,000 @ Rs 100/- per acre	2,88,00,000 @ Rs 300/ per acre
Orchards	300	1,92,000		96,00,000 @ Rs 50/- per acre	2,88,00 000 @ Rs 150/ per acre
	2,850	18,24,000	1,72,80,000	5,95,20,000	17,85,60,000

Today 1575 sq miles are under jungles, 307 sq miles under sand and 544 sq miles are under water, and the area of the land fit for cultivation is 675 sq miles or 432,000 acres Total yield @ 10 maunds per acre would be 43,20,000 mds of which half *i e*, 21,60,000 maunds are destroyed by wild animals (*boars, nilgay*) and birds The price of the remaining half at the pre-war level would be Rs 43,20,000 (@ Rs 2/- per md) and at the present rate it would be Rs 1,29,60,000 Now, if we subtract Rs 1,29,60,000, the present total income, from Rs 17,85,60,000 the total income before the advent of the Kosi in the area at the present rate, we have the total annual loss of Rs 16,56,00,000

(2) *Mortality*

The area at present affected has the number of deaths as 7,83,000 in round figures since 1923

Malaria	5,10,000
Kalazar	2,10,000
Cholera	60,000
Small-pox	3,000
	7,83,000

Besides these, we have a number of diseases like dysentery, hook-worm, dyspepsia, scabies, typhoid and pneumonia which either cause death straightway or lead people to it through extreme devitalization "

It will be noted that in (1) *i e*, financial loss, we have not considered the devastating effects of the Kosi water on the cattle in the belt Subsequently we shall have occasions to make observations on these But leaving aside the question altogether, for the time being, and even giving some discount in the figure representing annual financial loss, we come to something most colossal and staggering Add to it the annual mortality the belt must be suffering and consider it in terms of avoidable tears and suffering

The total flood affected area as given in the same report is spread over the following districts —

"North Bhagalpur (area 2110 sq miles, population 11,35,818), Eastern parts of the district of Darbhanga (area 672 sq miles, population 5,21,344), North Monghyr (area 500 sq miles, population 3,40,000) and Purnea (area 200 sq miles, population 1,00,000) Thus roughly, in round figure, total area at present affected is 3500 sq miles with a total population of 21,00,000 "

This area as affected by the Kosi, can be roughly divided into two regions by the longitude of 87° East The eastern portion was the region which first suffered from the consequences of floods but has now been abandoned by the Kosi migrating westward The western region is at the moment actively suffering from the floods If the two maps given here are compared it will be observed that the Kosi with most of its important distributaries flowed east of the longitude of 87°E, even in 1920 But when the area was subsequently mapped in 1945, the channels were found to have migrated westward And this is the problem of the Kosi But why should the river shift so swiftly? The answer is to be found in the hydrology of the river

Hydrology of Kosi

The Kosi has been formed by a number of tributaries combining together near the temple of

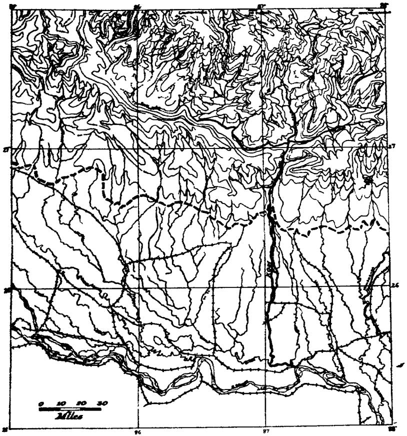

FIG 1 shows the position of the main stream of the Kosi and its important distributaries They all flowed east of longitude 87°E as will be seen in the map This was up to the year 1920 The western distributaries had not yet developed to any marked degree

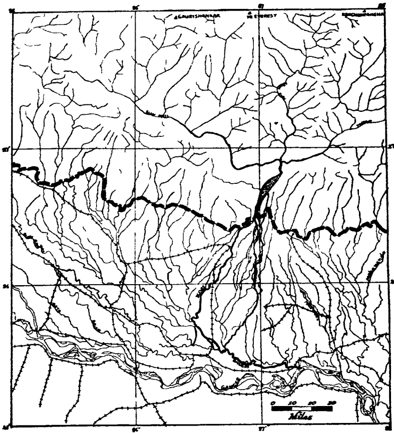

FIG 2 shows the position of the main channel of the Kosi and the important distributaries when remapped in 1945 The river had swung over to the west of long 87°E and the western distributaries had attained prominence The eastern ones have started drying up The swing belt of the Kosi extends over a terrain 70 miles in width

Barahakshetra The Sun Kosi, the Arun and the Tamur are the most important The Sun Kosi has a catchment area of 7,424 sq miles, and the catchment areas of the Arun and the Tamur are respectively 14,106 and 2,278 sq miles The combined catchment areas of the three tributaries spread out in the form of a big fan converging in a narrow gorge just south of the confluence The gorge abruptly ends in flat plains with insignificant slopes of 0 5 to 2 feet per mile The position is similar to that of the Mahanadi where the run off of the Plateau, emerging from the Naraj Gorge has to roll over the flat deltaic lower course The situation is further complicated by the direction of the rain bearing winds The lower portion of the catchment receives rain first followed by precipitation in the upper valley This also keeps the lower portions of the Kosi channels inflated when the run off from the upper region arrives on the plains It is no wonder therefore that spates with water levels shooting up 30 feet in 24 hours are frequent during the monsoons

Basic data as regards the precipitation in the catchment area or the discharge of the river at different sections are not known so far It is not possible therefore to give a correct estimate of the water resources that have to be tackled or the water balance that can be utilized for different purposes Vague generalizations and assumptions as regards the average precipitation, run-off and discharge of the Kosi have been made One estimate places the average rainfall to be 60″ with 60 per cent run-off This makes the total run-off to be $(23{,}808 \times 640 \times \frac{60}{12} \times \frac{60}{100})$ or 40,700,000 acre ft , roughly 40 million acre ft

We do not know whether such generalizations are permissible in absence of the minimum of observations, because according to the same authorities no rain gauges exist in the Kosi catchment area in Nepal

Solution

Various solutions for the flood problem have been offered from time to time From embankments of different kinds up to construction of reservoirs on multipurpose basis have been suggested In the context of river developments of the present day in different parts of the world, plans of integrated development of the valley has to be worked out for the Kosi Plans for the Damodar have been worked out and the Mahanadi is also being attended to The Kosi too deserves similar consideration But unfortunately for us our information with regard to the Kosi are still more meagre Hydrologically, we have earlier mentioned, the Kosi is almost a 'terra incognita' Geologically the position is worse still Nepal had so long kept aloof from any geological prospecting It is only recently that two excursions have been made into the gorge area of the river and this again under circumstances that prevented efficient working A skeleton sketch has no doubt been made available as a result of these excursions but this has raised more points for solution rather than solved them One of the important findings is that the whole gorge is involved in a series of tectonic disturbances and that the geological formations are not in their normal orders of superpositions The two sides of the gorge do not have identical construction facilities And

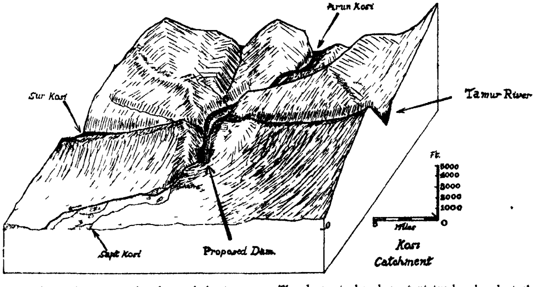

Fig 3 shows the geomorphic form of the terraine The dam site has been tentatively placed at the position indicated by the arrow It is worth investigating whether it can be better replaced by three dams across the tributaries shortly above their respective confluences

the most worrying of findings is that the gorge has been within the zone of maximum intensity of the past several earthquakes that shook Nepal, Bihar, Assam and Bengal Dr J B Auden of the Geological Survey of India and Mr Nickell of T V A therefore, feel that through hydrologically the gorge offers the most convenient site for storing the run-off of the Kosi catchment and regulating the flow for multipurpose basis lower down, yet it may have to be very thoroughly investigated In fact, it appears likely, as Dr Auden suggests that the purpose would be better served and the risk minimised if three separate dams be constructed across each of the three important tributaries, the Sun Kosi, the Arun and the Tamur shortly above the confluence It was not possible for him to carry out geological prospecting for these sites within the time alotted to him We would urge upon the Government to take this point into serious consideration

It is encouraging to find that the Central Water Power Irrigation and Navigation Commission appears to be cognisant of the fact that thorough investigations are necessary before anything conclusive may be said about the Kosi Valley Development Scheme We think that the following investigations should be carried out prior to any concrete proposal being presented before the people and boosted in the press —

(1) Topographical and Geological Survey,
(2) Hydro meteorological Survey
(3) Sub-soil Water Survey,
(4) River behaviour in the plain tract,
(5) Soil erosion and run-off, and
(6) Soil Survey

It appears to us a very wrong principle, that dams are being planned first on the main river, without first tackling the tributaries Thus for the Mahanadi, the proposed dam at Hirakud is just below the point where the main river is joined by the big tributary, *viz* , the Ib Common sense tells us that if there be simultaneous and catastrophic precipitation in the valleys of the tributary and the main river, the dam would have to face very serious conditions It appears to us that it would be easier to tackle the floods, if the tributaries *Hasdo, Ib and Tel* were first damed, and the main dam on the Mahanadi were located at Tikherpara In the case of the Kosi also, we think that dams should first be constructed on the three main affluents, and later, a big dam may be constructed on the Kosi

ROLE OF BORON IN CROP PRODUCTION

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INTRODUCTION

RECENT researches in plant nutrition have conclusively established the importance of certain micro-elements in stimulating growth of plants Boron undoubtedly belongs to this class(2, 9, 12, 15, 20, 24, 27, 31) Its occurrence in plants is fairly widespread and traces of boron compounds are helpful in growth and metabolism Seeds usually contain small quantity of this element but this supply is seldom commensurate with the requirement for normal growth This has been shown in plants of different habitat and growth behaviour with the result that boron deficiency is now known to cause widespread physiological diseases

BORON DEFICIENCY SYMPTOMS AND DISEASES

Lack of boron causes genuine damage to plants(3) Growing plants are mainly affected , short and stumpy roots are formed Deficiency results in downward curling of leaves with corky and splitted midribs In severe cases multiple bud formation, splitting of bark, oozing of gum, exposing of wood, dieback of apical growing point, reduced flowering and decay of roots are also observed Tendency to root malnutrition, defective solvent action, wilting and physical deformities have also been noted(41) Symptoms of deficiency appear early and develop quickly and usually mask other deficiency symptoms, if present Relative tolerance of species and life span determine the extent of development of deficiency symptoms in different plants

In citrus, meristematic tissues are primarily affected, followed by gum formation and carbohydrate accumulation Curling of leaves, degeneration of cambium and phloem and finally abscission are noticed(17) Lemon seedlings are more sensitive in this regard than orange seedlings In sugarbeet,

heart rot, crown rot or dry rot disease is associated with lack of boron Blackening of leaf tip(7), development of dark green thick leaves, pimpling of petioles, tendency to wilt, development of surface cankers, red pigmentation(38) and poor root development are characteristically noted Discoloration and rotting of upper portion of root and formation of dense short green top later in the season often results in low yield and poor sugar content The disease is cured by judicious boron application(4)

In tomato, bearing is reduced in absence of boron Fruits are covered with scattered darkened or dead areas In cabbage, internal breakdown in pith is noted, cabbage is less susceptible in this regard than cauliflower Dwarfing amid distortion of leaves, poor but formation with concentric water soaked areas, surface browning, bitter flavour are some of the symptoms which appear year after year regardless of soil type and weather conditions(19) more so under acidic soil reaction

In potato, deficiency causes development of thick leaves rolled in a manner characteristic of leaf roll Brown discoloration of vascular rings and in severe cases their glassy appearance has also been recorded Top sickness of tobacco, a boron deficiency disease, results in light green colour of bud leaves, distortion of leaves during expansion, twisted top growth and dieback of terminal bud Growth remains stunted and flowering is inhibited Injury is more pronounced in vigorously growing plants In deficiency cultures, pea plants exhibit short thick roots with enlarged root apices and suppressed growth of secondary roots Withering of shoot apex and internal disorganisation of tissues have been recorded in broad beans Boron deficient barley remains normal but susceptible to attack of *Erysiphe graminis* Wheat exhibits abnormal tillering with no ears or ears badly developed and sterile In maize, chlorosis of tissues between veins of old leaves, failure of young leaves to unroll, subnormal development of lamina, disturbed meristematic growth and disorganisation of tissues are recorded Partial sterility and poor cob formation is also noted In oats, straw is increased but grain is reduced in deficient cultures

Marginal yellowing of foliage followed by purpling and scorching have been noted in turnip Roots remain small, shrivel up and usually rot causing typical brown heart and black heart disease of turnip In celery, deficiency causes cracked stem disease In lettuce, typical deficiency symptoms also appear Flax plants in absence of this element sooner or later perish Decay of growth points of shoots is noted to take place Sugarcane in water cultures(3) shows depression in growth and distortion and chlorosis of leaves, definite stem and leaf lesions are formed As a rule, meristematic tissues are seriously affected Other crops like cotton, red clover and buckwheat also need boron in small quantity In apples(22), physiological disorders, drought spots and corky core(10) have been noted in boron deficiency medium Severe cases fo die-back and rosette have also been recorded in boron deficient soils Fruits formed are small, of abnormal colour, pebbly to touch and usually drop early Heart and dry rot of mangel is a boron deficiency disease Crops affected by boron deficiency also include marigold, swedes, strawberry(21), rice, *Brassica sp* (5), poppy, spinach, soyabean, castor, sweet potato, carrot, coffee, pumpkin, safflower, and onion In fact, deficiency of boron is of great economic importance(24) than those of other minor elements A comprehensive list of crops affected has appeared elsewhere(11, 35)

Symptoms of Boron Toxicity

While the response of boron is almost universal, the critical limit to which it could be profitably applied requires careful determination Improper use of this element proves toxic Potassium fertilisers containing excess of boron show harmful effects Development of toxic symptoms depends largely upon the source of irrigation water, the nutrient status of the soil, method of application of fertiliser, seasonal conditions, crop requirement, and soil type In citrus and walnut, leaves turn thin, mottled, chlorotic and crinkled when boron is in excess Leaf injury followed by marginal or spotted browning and premature defoliation are also recorded In tomato, yellowing, development of brown spots and mettled appearance of leaf have been reported in toxic cultures Dry rot of beet is also considered to be a boron toxicity disease Trees of stone fruits seldom exhibit such toxic symptoms No specific histological changes have been recorded in prune, peach, apricot and grapes In all cases of toxicity, chloroplasts, if present, are first to be affected Progressive degeneration of protoplasm takes place Toxic symptoms are accompanied by reduced uptake of calcium and are suggested to be related to lack of availability of iron in presence of heavy doses of boron Leaching with water or treatment with ferrous sulphate is recommended to overcome toxicity

Boron Requirement of Plants

The enormous amount of literature on boron nutrition reveals that chemical combination in which this ingredient is presented is immaterial, even insoluble borates are helpful in avoiding deficiency diseases What is needed most is an adequate supply spread over the entire life cycle The range of usefulness and toxicity differs markedly as shown by the figures quoted below for some crops

Plants	Useful doses	Toxic doses
P multiflorus	1 12500000	1 5000
I carnatum	1 25000	
Sunflower (13)	0 5 ppm B	1 ppm B
Tomato	0 5 ppm B	5 5 ppm B
Alfalfa (16)	15 lbs borax/acre	
Cauliflower (42)	5-10 lbs borax/acre	20 lbs borax/acre
Cabbage	20 lbs borax/acre	
Sugarbeet	10-20 lbs borax/acre	
Field beans (30)		12 lbs borax/acre
Swedes	20 lbs borax/acre	
Turnip	10 lbs borax/acre	
Apples (8)	0 5 to 1 lb borax/plant or 0 25% B solution as injection	
Citrus	25 100 gms of borax/plant	

These limits however, are likely to vary with the nutrient status of the soil in different localities On the basis of their response plants could be conveniently classified into (i) plants of high boron requirement, e g , legumes, sunflower, cotton, buckwheat, castor, bean, flax, and mustard , and (ii) plants of low boron requirement, e g , cereals candituft Comparative analysis of the plants(40) has also confirmed this view Carrot, for instance, contains a higher percentage (25 mgm /kgm dry weight) of boron than cereals which show fairly low concentration of 0 1—0 3 mgm /kgm dry weight of boron As against this, the figures for tomato, tobacco, bean, potato, and pea are about 18 mgm /kgm dry weight Beet shows still higher concentration of 75 mgm /kgm dry weight In plants of low boron requirement, small quantity supplied with the seed or available through contaminations satisfies the growth requirement Evidences so far produced indicate in general best response of plants in trace boron cultures (0 03—0 04 ppm or 1 ppm) In some cases growth is increased even in 10—15 ppm cultures Considerable overlapping of injurious and beneficial effects have been noted(14) Tolerance studies based on percent age ratio of $\frac{\text{Dry weight in high B Cultures}}{\text{Dry weeight in trace B Cultures}}$ show that these values range between 10 and 200, the lowermost for most sensitive plants while the higher for tolerant species No relation between boron tolerance and boron accumulation characteristics of different species recorded

Plant and Soil Tests for Boron

Boron requirement of different species, their power of absorbing this element and the ability of plants to show characteristic deficiency effects earlier than others appear to be related In view of this certain indicator plants like turnip, sugarbeet, tobacco sunflower(6, 28) are most helpful in preliminary soil tests. Aided by nutrient cultures they may help in establishing (i) whether or not a particular crop is likely to suffer from lack of boron , and (ii) the extent to which boron as a manure would be able to help in increasing production

Leaves of all stages and stems in young plants are sensitive indicators of boron content of soil(30) Low boron concentration (10 ppm in plants) is correlated with high incidence of disease, higher concentrations (above 14 ppm) are associated with freedom from disease In diseased apples boron content has, in one instance, been shown to fall down to one third the normal value Percentage is noted to be inversely proportional to the severity of the disease Plant tissue analysis has proved useful in diagnosis of boron deficiency in beet as well(1) Expressed juice contains less boron than remaining plant residues(42) No consistency however, has been noted even in a single species Margins in lemons show thirty times as high a concentration of boron as in the mid-vein and petiole In grafted varieties, boron content of scion leaves is affected by root stock , if the latter is high in boron, scion leaf concentration is reduced Intake of boron is determined by the characteristics of the absorbing region, nature of boron compounds in the plant and the equilibrium between mobile and non-mobile compounds In most cases quantity absorbed is related to quantity available(33)

Boron present in soil is divided into three categories(1) (i) total boron, (ii) acid soluble boron and (iii) water soluble boron Of these, the water soluble boron shows highest correlation with the incidence of disease Extraction in boiling water for five minutes appears to be one of the best methods of estimating available boron in soil A critical discussion of the method of estimating boron appears elsewhere(35)

Secondary Effects of Boron

Boron brings about many secondary effects in soil Applied in form of borax it increases microbiological activity , fungus population is affected more than bacterial Growth of *Trichoderma* is confined to borax treated soils In limed soil, borax is fixed mostly due to microbiological activity(18) Boron deficient nodules in legumes show a remarkable development of rods and cocci which become easily parasitic and destroy the protoplasm of host cells Boron supply and apical dominance appear to be also related Abnormal tillering in monocots is noted alongside withering of growing points in deficient cultures

Boron added to soil decreases its iron content Apparently solubility of iron in soil is inhibited Development of chlorosis in toxic cultures is thus more due to lack of available iron than excess of boron added to soil Indol-acetic acid to a certain extent is suggested to replace boron Boron deficient and

auxin deficient plants develop similar symptoms though the responses are not always equal(13)

Environmental Effects on Boron Response

Certain conditions in soil help to bring about or check boron deficiency diseases Thus corky core and drought spot of apples and black heart of turnips are prevented in high carbonate soil Soils saturated with calcium however show boron deficiency symptoms in some plants, yet browning of cauliflowers occurs more in distinctly acid soils(19) Ill effects of over liming in turnips, oats, cabbage, tomato, and soyabean has been cured by boron application(7) In sandy soils boron deficiency is made more acute by liming without the soil solution approaching an alkaline reaction(38) Different soils show differences in the degree to which available boron is tied up by liming The reaction of the medium plays a vital part Internal black spot of garden beet, for instance, is noted more in soils with neutral or alkaline reaction(38)

Requirement of boron is also found to vary with the amount of certain other salts in solution Thus when phosphorus is present in solution, plants grown without boron are normal except in fruit setting Increased potassium delays or eliminates symptoms of boron deficiency Moisture and nitrogen content of the soil influence boron availability and response also(19) Magnesium hydroxide reduces availability of soil boron most, calcium, sodium and potassium hydroxides are less effective(42)

As a rule low boron soils show deficiency symptoms In rich soils, continuous cropping and leaching depletes boron considerably and thus lowers its concentration to deficient level In soils of high *p*H, deficiency of boron(42) results from its fixation during denitrifying processes going on at greater pace Other factors of soil composition treatment or climate sometimes restrict the availability of this element(8) Heart rot of sugarbeet for instance, is more severe in dry years but not in wet seasons Onions, radish and carrot accumulate several times as much boron in their roots, relative to that in leaf, when grown in winter as when grown in summer(14) In broadbeans, high boron concentration is more injurious in early spring or autumn than during summer High light intensity and temperature during summer prevents movement of boron from leaves to other organs In peas and barley reduced length of the day rather than lower temperature controls delay in the appearance of boron deficiency symptoms during spring and autumn as compared to summer

Experiments under control conditions have shown that lack of boron exerts more fundamental influence on the plant than reduction in the length of the day In the former case, stem apices die irrespective of light conditions, recovery takes place only on substituting this element Factors affecting translocation and distribution of this element in plants appear to be equally important in determining boron requirement than boron supplying power of the substrate

Boron Supply and Absorption of Elements

Boron affects calcium uptake considerably(39) Total calcium taken up has been noted to be reduced in boron deficient plants more than that of K and N Nitrogen, if at all affected, shows slight variation Higher nitrogen content of straw and grain of wheat has however, been recorded in plants treated with boron Absence of this ingredient from single salt solution causes rapid death Other elements, if present, increase requirement of boron and calcium both Renewal of solution delays appearance of deficiency symptoms and prolongs absorbing capacity of the plant Under heavy doses of boron, decreased calcium absorption is noted *Per contra,* heavy calcium injuries are mitigated by boron compounds In corn, soluble boron content is highly correlated with total soluble or active calcium of the tissues(34) In soyabeans, production of fresh tissue and percentage of calcium are conditioned by boron concentration in the medium Total ash content does not vary so much as calcium content of ash Boron, in general, aids absorption and utilisation of calcium more than others(29)

Boron Supply and Tissue Composition

Under boron deficiency leaves tend to develop purple colour and show more starch and total sugar than the control Stem on the other hand contains less sugar Benzene soluble matter is also increased Boron appears to play some part in carbohydrates and fat metabolism(34) Some relationship with pectin content is also recorded(26) Proportion of other materials also differs markedly Under extreme deficiency acidity develops in stem tips, ammonium nitrogen accumulates in these acid cells alongside sugars Progressive degeneration of protoplasm also takes place Course of photosynthesis appears to be altered(37) to bring about changes in composition

Boron Supply and Plant Anatomy

Absence of boron induces several abnormalities in plant anatomy All tissues where growth and cell division are taking place are affected Hypertrophy of cambium cells, disintegration of phloem and ground parenchyma, poor development of xylem and poor lignification are noted in deficient plants, Phloem necrosis is noted in petioles, stem and other regions as well In tomato(32) cell wall turns brown; leaf cells

enlarge and thicken Flower buds, stalks and flowers all exhibit internal degeneration and die prematurely In prunes, peaches, grapes and citrus xylem disintegrates forming gum pockets In deficient sugarcane, lignified fibre cells are small, poorly developed and loosely arranged, enlargement of cells and deep constrictions internally in the injured regions of young leaves are also observed In pea, root apices enlarge, cells cease to divide normally and undergo pathological change. Xylem elements appear isolated Secondary root primordia develop abnormally close to the root tips In beet(23), hypertrophy of cambium, degeneration and necrosis in primary and secondary xylem, intercellular brown deposits and cell enlargement and proliferation extending to mesophyll and spongy parenchyma, and floral axis are recorded In cabbage, proliferation of cambium results in formation of undifferentiated tissues In general, metabolic processes concerned in cell division, cell differentiation and storage are affected chiefly by boron deficiency

Conclusion Physiological Role of Boron

Boron appears to function as a nutritive rather than a catalytic agent Its action is suggested to be analogous to vitamins in animal life It seems to be soon fixed up and is not in a state of circulation The possibility of its acting merely as an antiseptic agent seems quite unlikely Acidifying action is also negligible as no appreciable change in pH of the medium is recorded

✓ It is widely distributed throughout the plant after absorption. Death of apical meristem is due to lack of some factor essential to growth and development of permanent tissue from meristematic cells, the latter in some way depends upon the presence of boron Boron, however, is not able to replace any of the major nutrients although a definite association with calcium absorption is recorded(34) The amount required is so small that it can hardly be a problem in nature deserving as much attention as any of the major ingredients Contaminations in some cases provide enough boron for plant growth ✓It is suggested that this element is✓ carried to the leaf along the transpiration stream as an inorganic radical On reaching the foliage, much of it is combined with organic compounds and is rendered immobile It tends to remain there and does not move freely along with sugars and other substances towards growing tissues(14) Translocation of this ingredient to bark and wood and finally to flesh of stone fruits is recorded. In leaves, boron is almost entirely dissolved in sap Large immobile molecules it seems, are formed as a result of which boron does not diffuse through plasma membrane It is also suggested to be fixed in plant tissues and thus cannot be used over and over again.✓

Boron is more a nutrient needed in small quantity than anything else It is considered to play some part in the regulation of the water relations of plasma colloids(29) and helps carbohydrate transportation and utilisation Course of photosynthesis is also altered(37) It is considered instrumental in regulating the distribution of materials through the various parts of the plant(25) It also serves to regulate accumulation of ions from nutrient solution(36, 37) Boron is suggested to be in some way related to formation of fat(34), pectin(26) and development of acidity Growth of stem is regulated more by boron than that of leaf or root Its proportion influences respiration also Low boron is associated with low respiration Type of metabolism which influence the keeping behaviour of fruits is greatly affected Comparative effects of iron and boron deficiency does not give any conclusive proof as to whether or not the action of boron is antagonistic to iron or whether it acts merely as a carrier of an essential element At least it is considered helpful in overcoming the toxic effects of certain heavy metals, *e g*, rubidium Malnutrition and defective solvent action of roots are associated with the absence of this ingredient Boron in traces is helpful in mitigating these effects It cannot be wholly replaced by any other element though manganese appears to be a better substitute than others Its role in the formation of hormones(13) and fat and carbohydrate metabolism(34) is yet little understood Much more work is needed to work out the mechanism of boron response and the manner in which boron helps in bringing about physiological balance in the nutrient status of the soil to ensure good growth

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MAGNESIUM BATTERIES*

IN course of the last World War, highly mechanised and mobile as it was, portable and self-contained sources of electrical energy had been the subject of intensive researches As a result, great improvements have been effected on the construction of dry batteries and accumulators Some inherent defects in the newly developed sources of energy, which would have prohibited their use in peace time, became causes of secondary importance in time of war Thus the question of price was of little consideration from the military point of view, certain important characteristics, such as lightness, increased mass and volume capacity, excellent performance at low temperatures justified some financial sacrifices to be made Further, certain peculiar difficulties of practical application, which might limit their use for civil purposes, did not present the same inconvenience in war, since the technical services of the army are now-a-days manned with an adequate staff of competent specialists

Magnesium in the Construction of Dry Batteries

It is not therefore surprising that a very old idea was taken up again for the construction of dry batteries, namely the employment of magnesium as anode in place of zinc (It may be remembered that the name anode applies to the soluble electrode although it corresponds to the negative pole of the battery) Magnesium was a rare laboratory substance only a few years ago but has now become a common material and, due to a slow-down in the production of aeroplanes, is disposable in large quantities Manufacturers have therefore engaged themselves in finding out new fields of application for this metal The replacement of zinc by magnesium for the cathodic protection of underground metal conduits is an important example of a new opening for this metal The use of magnesium in the construction of dry batteries constitutes another example

A comparison of the electro-chemical properties of the two metals will show that magnesium is considerably superior to zinc.

	Electrode Potential	Electro-chemical equivalent in Amp hour per kg
Zinc	0 76 V	2200
Magnesium	2 4 V	815

In theory at least, for the same weight magnesium can yield 2 7 times more current under a tension three times greater than zinc Magnesium was envisaged, since 1885, particularly by Heim, as a possible material for the construction of dry batteries but at that time, this metal, like aluminium, was only a laboratory curiosity and its high price prohibited its industrial utilization To day it is no more so and magnesium batteries have been developed as a result of numerous investigations carried out since 1925.

Magnesium-Carbon-Chromic Acid Battery

The magnesium batteries first produced depended on the use of the magnesium-carbon couple, with chromic acid or a bichromate as depolarizer. The main trouble was that it was difficult to obtain with

* Translated from *La Nature*, March, 1948

magnesium a continuous discharge at a relatively constant potential, the metal gets fatigued in course of the discharge and chemical corrosion takes place during periods of rest Chromic acid is a very good solvent of the products resulting from the action on magnesium during the discharge but has no effect on open circuit The tension, however, was low and it was not possible to obtain large discharge currents

Substantial improvement has been achieved recently by the use, on the one hand, of complex electrolytes containing side by side with chromic acid other constituents such as phosphoric acid and sulphuric acid and, on the other hand, by employing certain alloys of magnesium instead of the pure metal Such alloys acquire the property of greater resistance to corrosion on open circuit if subjected to a thermal treatment, for instance, heating to a temperature as high as 600°C followed by immersion in water at 80°C

The compositions of the alloys and electrolytes which have given best results in experiments recently carried out in the U S A are given below

Cell No	*Composition of Alloy*				*Composition of Electrolyte*		
	Mg	Al	Zn	Mn	CrO_3	H_3PO_4	H_2SO_4
1	92 3%	6 5%	1%	0 2%	40%	23%	
2	98 5%			1 5%	40%	23%	
3	92 3%	6 5%	1%	0 2%	40%	20%	
4	92 3%	6 5%	1%	0 2%	40%	15%	0 01%
5	92 3%	6 5%	1%	0 2%	45%	20%	0 01%

With these different constituents, cells were prepared with a magnesium anode measuring 5 1 × 8 9 × 0 63 cm and a carbon electrode measuring 10 cm sideways, capable of containing 500 cm³ of electrolyte These cells were discharged at current densities ranging from 1 to 6 milliamperes per sq cm, but the variation was found to have no sensible influence on the tension Their characteristics are shown in the following table

Cell No	Initial tension on closed circuit	Capacity in amp hr	Yield
1	1 31 V	28 4	84%
2	1 58/1 71 V	28 3	68%
3	1 11 V	25 8	60%
4	1 18/1·24 V	25 3/29 3	80/83%
5	1 07/1 22 V	26	82%

Cell No 2 has the highest tension This tension is not obtained at the cost of capacity but of a slight diminution in the yield The discharge curves for the magnesium cells are very interesting As shown in Fig 1, the curves are substantially flat up to 1 V for cell No 1 and to 1 5 V for cell No 2 These batteries are still only in the first stage of realisation,

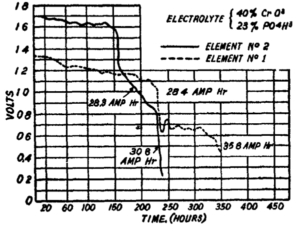

Fig 1 —Discharge curve of cells Nos 1 and 2

yet they are noteworthy for their electrical characteristics as well as for very small chemical corrosion on open circuit For the same volume, a battery of this type yields practically the same energy output as a classical battery with zinc anode, copper cathode, oxide of copper as depolarizer and caustic soda solution as electrolyte

Magnesium-Carbon-Saline Solution Battery

A few years before the war, a number of patents for this type of battery were submitted by an inventor named Gordon Since then, this battery was the subject of numerous researches mainly in England, then in Canada and the U S A There is still difference of opinion regarding its industrial possibilities, yet it appears to have already found some applications, either for the manufacture of pocket batteries or of batteries meant for radio receivers On the more industrial side, its use as an entirely independent source of electrical energy has also been envisaged, and batteries have been manufactured for working domestic refrigerators placed in localities having no electric supply line as well as for supplying the energy needed for propelling small boats, specially fishing boats This battery functions by being simply filled up with saline solution, particularly sea-water, it is only necessary to dip the electrodes in the sea to obtain a current and to take them out of the water to stop it

The Americans have even thought of solving the important problem of electric traction, which is so important in towns poor in combustible liquids, by employing these light-weight batteries It is suggested that the low price of magnesium is going to make

this method of producing current a practical proposition and some simple methods of assembly have been evolved which will allow the change of electrodes when used up, as easily and quickly as the motorist fills up the tank of his car It may appear that these ideas are still premature but according to a specialist these magnesium batteries will be of general use in the near future even though they are not so at present

The Gordon battery is essentially built up of magnesium anodes and carbon cathodes, the electrolyte is a saline solution, depolarization being assured by the oxygen of the air The whole problem thus reduces to the preparation of cells in which the access of air is sufficient to enable the battery to deliver current of the order necessary for industrial applications

If a rod of carbon and a rod of magnesium are dipped in saline solution it will be difficult to obtain appreciable current In order to get better results it is necessary to wrap the magnesium rod with a fibrous material very sparingly soaked with the electrolyte in such a manner that air may copiously reach the interstices

In its simplest form the Gordon battery consists of a magnesium rod surrounded by several spirals of loose cellulose packing, the whole being introduced in a tube of carbon The tissues extend beyond the bottom of the magnesium rod and plunge into the saline solution so that the latter rises up by capillary action and moistens the tissues In practice, three magnesium rods are generally mounted in parallel to increase the active surface area, each being wrapped up with a tissue The metal used for the preparation of anode is not pure magnesium It generally contains 1 per cent manganese to increase the hardness and 5 to 6 per cent aluminium in order to make it more ductile Other metals in minute quantities are also added with a view to make the action of the metal more regular and to avoid local corrosive actions which check the production of current

For the manufacture of batteries for pocket lamps a slightly different method of construction is adopted The salt meant for improving the conductivity of the electrolyte is compressed in the form of a tablet and is placed at the lower part of the tissue It is enough to introduce from time to time a small quantity of water in a tiny capsule moulded in the form of a reservoir and placed at the bottom of each cell The water dissolves the salt and rises up by capillary action between the electrodes When the battery is dry it is absolutely inert and does not undergo any corrosion When, on the contrary, water is added it begins to work

The electromotive force of this battery on open circuit is about 1 6 volt In closed circuit its tension varies as a function of the current output and in some cases it may go down to 0·7 volt. Fig 2 shows a curve of discharge at 100 mA for a small magnesium battery It is found that during almost the whole duration of the discharge the tension remains practically constant It is in continuous service that this

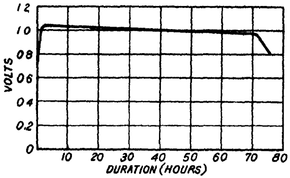

Fig 2—Discharge curve at 100 mA of a Gordon battery

battery gives better results, it does not polarize and does not require any time of recovery like ordinary dry cells

When it is reactivated with water, the tension, weak at first, rises till the tissue is completely saturated with the liquid It takes 30 to 40 seconds for this rise and this slight delay is practically of no importance in most cases

Besides the cells for pocket lamps or for deaf-aid apparatus, batteries of the Gordon type are made in three different forms The smallest is 12 5 cm in length and 5 cm in diameter It is composed of a mantle of carbon having inside it three magnesium rods 11 cm in length and 1 cm in diameter This battery may supply a current of 100 mA at 1 volt for 400 consecutive hours The second type measures 12 5 cm in length and a little more than 6 cm in diameter It consists of 5 magnesium rods and can supply the same current at the same voltage for 600 hours The third type measures 12 5 cm in length and 7 8 cm in diameter and contains 8 magnesium rods At the same rate it can supply current for 1000 hours

The relative weights of these cells are 225 gms, 300 gms and 420 gms respectively Nothing stands in the way of constructing cells of other sizes since the capacity depends essentially on the surface area of magnesium exposed to the action of the electrolyte As a result, a battery of this type may be designed with as much precision as a lead-acid battery*

Investigations are continued with a view to improve the characteristics of the magnesium cell

Thus efforts are being made to reduce its internal resistance and to facilitate the access of air in order to obtain greater output It has also been noticed that the voltage falls down after each interruption of the discharge It seems that this defect is caused by the presence of impurity in the carbon and attempts are being made to obtain electrodes free from ashes

Magnesium-Silver Chloride-Water Battery

In the beginning of the war need was badly felt of batteries having very large capacity but with little complications and minimum possible weight The ordinary dry cells and the accumulators did not satisfy these requirements Thus the construction of cells employing magnesium and silver electrodes, silver chloride as depolarizer and water or saline solution as electrolyte was envisaged The use of silver chloride as depolarizer is not new for this substance has been already used in the construction of cells similar to Leclanche's cells and containing zinc as anode , but these batteries had very low tension, of the order of 1 volt, and could not furnish quick discharges The use of magnesium has won over these difficulties

The magnesium-silver chloride cells are manufactured in two different forms depending on whether they are required to deliver large current at low tension or low current at high tension

The positive electrode is made up of a silver foil 25 to 75 microns thick, on the surface of which silver chloride is deposited by a patented electro-chemical process The negative electrode is a pure magnesium foil of the same thickness In batteries having low tension a layer of absorbent paper is interposed between these two foils and the whole is then rolled up If this operation is performed under suitable conditions, for instance, in factories wherein the temperature is controlled at 27°C and the relative humidity is less than 25%, the cells once rolled up in tight packings may be preserved indefinitely At the time of use, it is enough to dip the cell in water or better in saline solution in order to activate it When batteries with two or three cells are to be made, the first cell is surrounded with a plastic film , round it the second combination is concentrically rolled up and so on In this way a simple concentric assembly is obtained enabling the storage of large electric energy

For the high tension batteries flat electrodes are used, having surface areas varying from 3 78 to 16 8 cm sq according to requirements In these cells only one face of the silver plate is coated with silver chloride Between two opposite electrodes is placed a sheet of absorbent paper and between two consecutive cells an insulating plate is interposed In modern radio-sonde equipments magnesium-silver chloride batteries consisting of a combination of a low tension and a high tension battery are largely used

Just before use these cells are taken out of their casing and the paper is saturated with water or preferably with saline solution in order to improve the conductivity of the electrolyte The battery attains its own tension in one or two minutes if filled up with water and within a shorter time if soaked in saline solution such as sea water.

The essential characteristics of this type of cell are —

(1) Light weight and small dimensions
(2) May be preserved indefinitely in the dry state, under any condition of temperature and humidity
(3) May be filled up with sea water or natural water Use of special electrolytes is avoided
(4) High voltage of the order of about 1 5 volt, capacity being maintained at an appreciable value even when the temperature falls down to −40°C
(5) Variation of voltage in course of discharge is very small as shown in Fig 3 which enables a comparative study to be made of a silver chloride cell, an ordinary dry cell and a perchloric acid battery, each discharged through a resistance of 10 ohms

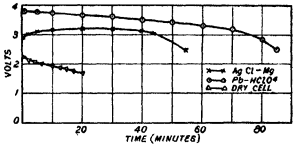

Fig 3—Comparison of an ordinary dry cell, a perchloric acid battery and a magnesium battery, discharged through a resistance of 10 ohms

One of the American manufacturers of this type of batteries produced during the war no less than 25 different models for the technical services of the Army and the Navy One of the principal uses of these batteries has been in the equipment of sounding balloons which carry a very small radio transmitter to great altitudes

Silver chloride cells have another important point of superiority , they are not sensitive to variations of temperature Such a cell having an electrode area of 150 cm sq , discharged through an external

resistance of 10 ohms, gives the same output at +20°C as at −40°C, the voltage in course of the discharge is reduced only slightly at the low temperature end On the other hand, the duration of the discharge remains practically unchanged Under the same conditions the duration of discharge of a perchloric acid battery is reduced to one-fourth Even if the discharge current is increased, the voltage of the silver chloride cell is only slightly reduced but the output capacity remains practically the same Thus a hundredfold increase of the discharge rate causes a reduction of the voltage from 1 6 volt to 1 34 volt while the capacity is reduced by only 10 per cent

The cells described above are all irreversible and therefore cannot be recharged It would be an achievement if one could construct accumulators, *i e*, reversible cells using magnesium as electrodes, at least as the negative electrodes Researches are being pursued in this line, if they are crowned with success the problem of light-weight accumulators which has been the subject of numerous investigations will be solved

Notes and News

MINISTRY OF SCIENTIFIC RESEARCH

CONSEQUENT to the creation of a separate portfolio of 'Scientific Research' in September last, of which Pandit Jawaharlal Nehru is in charge (see SCIENCE AND CULTURE, September 1947, p 108), the Government of India have now created a separate Department of Scientific Research with effect from June 1 last

The Department will work under the Prime Minister and Dr Shanti Swarup Bhatnagar, Director, Scientific and Industrial Research has been appointed the Secretary and Principal Executive Officer The department has taken over the work of the Board of Research on Atomic Energy and the Council of Scientific and Industrial Research The latter will however retain its unofficial character and function as before

The new department will tender scientific advice to Government departments and deal with *ad hoc* scientific research in universities and institutions, Scientific Consultative Committee, and the international scientific unions It will further co-ordinate the scientific activities of other ministries through a co-ordination committee consisting of eminent scientists

Presiding over a meeting of the Governing Body of the Council of Scientific and Industrial Research on July 17 last, Pandit Nehru said that the newly created *Department of Scientific Research* had been formed for future scientific developments in the country Matters connected with atomic energy involved dealings with other countries and control of raw materials connected with atomic energy development and production was also essential and hence required special attention in the hands of a separate department Close liaison, however, would be maintained with the Ministry of Industry and Supply The setting up of an Atomic Energy Commission to enforce the Atomic Energy Act was under Government's consideration

The Council recommended to the Government the production of alternative synthetic petrol (synthesis of liquid fuel from coal) It is proposed to extract 1 million tons of motor spirit and diesel oil by extraction from coal estimated to cost about Rs 65 crores Messrs Koppers, a U S firm are appointed as consultants to advise the Government of India on this question A batch of experts have arrived in India and a report will be ready by middle of September

The Council further recommended the increased production of power alcohol, establishment of field survey station in Assam for the survey of coal and petroleum deposits in the province, and the establishment of a high altitude research station and laboratory in the Himalayas for the survey of Himalayan resources in minerals, animal and plant life, and investigations connected with cosmic ray research, astronomy, meteorology, snow survey and Glaciology

The Council further approved of the proposal for the establishment of a Central Road Research Institute and a Central Building Research Institute at Roorkee at an estimated cost of Rs 175 lakhs and Rs 5 lakhs respectively These are the two engineering research organisations to be set up in the chain of National Laboratories sponsored by the Council

A committee was also set up to investigate the possibilities of utilizing natural deposits of mixed salts

THE UNIVERSITIES AS CENTRES OF SCIENTIFIC RESEARCH

On May 10, 1947, the British Association's Division for Social and International Relations of Science held a conference in the University of Manchester on the Place of University on the Community

The Chairman, Sir Henry Dale, O M , G B E , F R S , discussed on the universities as centres of scientific research and the source of their financial support It was obvious that the universities were just emerging from wholly abnormal conditions imposed by the war, when the activities of almost every science department were very largely given over to work directly or indirectly undertaken for the Government on prescribed mostly secret projects The universities were emerging from that obligation but were finding themselves already dependent for 75 per cent of their income on money from the public purse The Government organisations which had supplied the funds, together with the nation's industries, had experienced for the first time during the war the full possibilities of prescribed and directed researches, carried out for them in the science departments of the universities It seemed desirable rather urgent now, to consider very carefully what was the proper normal function of research in the universities Sir Henry stated that the particular function of the universities was that of independent research, and the advancement of fundamental science would be regarded as the particular task of research in the universities Of course researches in the sciences ancillary to agriculture and to medicine tended to be applied research, but no body would desire to exclude them for that reason from the activities of the universities The real distinction was between free or independent researches, undertaken with no obligation to keep to a definite course or to limit activities to the solution of a pre-ordained problem, and prescribed researches, undertaken to solve a prescribed problem The special function of the universities was free research rather than prescribed research The universities should then have the special function of encouraging investigations having no obvious relation to applications which could be foreseen, though, according to all experience, such researches very often led to practical applications more important than those which come from researches undertaken with a prescribed and practical object

The object, then, of the universities was to promote researches undertaken with no practical objective but to widen the boundaries of knowledge and to discover truth for its own interest and for its cultural value That should not exclude even contract researches commissioned by some outside body, if freedom were allowed, and if the offer of financial support for an attack on a named problem did not divert the academic worker from the natural line of his own ideas

Sir Henry mentioned that he had recently made this suggestion in the course of a lecture in the United States of America, and had met with a surprising unanimity of approval from scientific colleagues, not only in academic circles, but in the centres of industrial scientific research as well In particular, the Director of one of the most important research organisations supported by industry in the United States said, "I think that you are absolutely right We ourselves support, and desire to support in increasing measure, research work of a perfectly free kind in the universities" (*The Advancement of Science*, *5*, 18, 1948)

ATOMIC PILE AT BROOKHAVEN

It is reported that the 'atomic pile' at the New Brookhaven National Laboratory, now under construction, will be the most flexible research pile in the world Among others, there will be facilities for bringing neutron beams out of the pile, for irradiating biological tissues, and for making studies of the characteristics of neutrons Provision has also been made for special research on materials used in connection with the construction and operation of atomic piles, and also on the engineering problems involved in atomic power production In general form, the Brookhaven pile will be similar to the Oak Ridge pile, except that the neutron density will be several times greater The pile, which will be air cooled, will be housed in a building approximately 120 feet long by 100 feet wide, and more than six stories in height The building will be flanked by two wings, each nearly 100 feet long, which will contain laboratories The whole structure will be approximately 320 feet in length Though operation of the pile will be so nearly automatic that one man could safely care for it, present plans call for two to three men per shift The pile is designed to operate on a schedule of seven days per week, 24 hours per day The plan for other equipment to be constructed includes a 'hot' laboratory for use in research on radioactive materials, a large cyclotron, and a Van de Graaff generator (*Journal of the Chemical Education*, April 1948)

URANIUM PRODUCTION PROGRAMME IN U S

It is reported from New York correspondent that the U S Atomic Energy Commission has

announced a three point programme to stimulate the discovery and production of domestic uranium by private competitive enterprise The major elements of the programme are —

1 Government-guaranteed ten-year minimum prices for domestic refined uranium, high-grade uranium ores and mechanical concentrates
2 A bonus of $10,000 for the discovery and production of high-grade uranium ores from new domestic deposits
3 Government-guaranteed three-year minimum prices for the low-grade carnotite- and roscoelite-type uranium-vanadium ores of the Colorado plateau area and Government operation of two vanadium-uranium plants in that area

The Commission recognises that, in line with the policies expressed in the Atomic Energy Act of 1946, development and production of uranium ores can be stimulated most effectively by the type of private operations responsible for the growth and efficiency of the American mining industry The AEC guarantees minimum prices for domestic refined uranium, high-grade uranium-bearing ores and mechanical concentrates The guaranteed minimum prices are $ 50 per lb of recoverable uranium oxide from uranium-bearing ores and concentrates, less the cost of refining and $3 50 per lb for uranium oxide Against the $13 80 per ton currently being paid by private industry for carnotite- or roscoelite-type ores containing 2 per cent vanadium oxide and 0 2 per cent uranium oxide, the Commission, for a period of three years, will pay producers $20 40 per ton for this grade of ore delivered to it at Monticello, Utah or Durango, Colorado The schedule provides for payment of $1 50 per lb of uranium oxide for the delivery of ores assaying 0 20 per cent, plus a development allowance of 50 cents per lb Premiums will be paid for delivery of certain higher grades of ore, however, and a lower price will be paid for delivery of ores containing less than 0 20 per cent uranium oxide with no payment for ores containing less than 0 10 per cent Payment will also be made based on the vanadium oxide content of the ore at 31 cents per lb for an amount not exceeding 10 lb per each lb of uranium oxide It is expected that the Monticello purchase depot will be ready to receive ore during July, 1948 and that the Durango depot will be in operation shortly thereafter

According to the Australian News and Information Bureau in New York, a move in a similar direction has also been made by the Federal Government in Australia It has been announced that discovery in Australia of a deposit of ore capable of yielding 25 tons of uranium oxide will earn the finder $3,200 and an additional allowance of up to $80,000 according to the richness of the find (*The Chemical Age*, May 22, 1948)

FUTURE ATOMIC ADVANCES

EXPERIMENTAL atomic power plants 'within a year or two' and ships running on atomic energy 'within a decade' were forecast by a famous American atomic scientist

The scientist is Dr Edward U Condon, Director of the National Bureau of Standards, who has been under attack from a subcommittee of the House Un-American Activities Committee Dr Condon's views on the future applications of atomic energy are given in a report to the American Institute of Electrical Engineers in New York on March 10 last

'Three atomic power plants are now under way —at Oak Ridge, Tenn , Chicago, Ill , and Schenectady, N Y —and it should be possible to realise experimental production of power within a year or two,' the atomic scientist forecast

For cars, planes or even railroad locomotives, atomic power plants are likely to be too heavy, he believes

"However, it is reasonable to suppose that within a decade some ships may derive their power from (atomic) piles '

Other atomic advances expected by Dr Condon include better ways of producing the atomic bomb elements uranium 235 and plutonium, smaller-sized chain-reacting piles, important 'special purpose energy sources' and aids in medical and other scientific work

Whether or not other elements can be used to release atomic energy 'can be decided only by future research,' declares the scientist

'At present no means of doing this is in sight, but it should be remembered that in 1938 the atomic bomb would have seemed fantastic to the best nuclear physicists ' (*Science News Letter*, May 22, 1948)

CHEMICAL WARFARE IN ANCIENT INDIA

KOKATNUR from New York City has suggested from careful investigation that India might lay substantial claim, both from its antiquity and historical evidence, to precedence as the country of origin of chemical warfare

The beginning of chemical warfare is generally traced to Greece The fact that many civilizations may have preceded that of Greece, suggests that the parentage of the Grecian civilization lies within the

annals of an earlier and perhaps greater dynasty. There is no trace of the employment of chemical warfare in the Illiad and the Odyssey, whereas the *Ramayana* and the *Mahabharata* have examples of it. According to General Maclagen, Quintus Curtius indicates that Alexander met with some fire weapons in India. The evidence coming from Greeks should not be neglected in connection with this chemical warfare. Themistocles mentions the *Brahmans* fighting at a distance with lightning and thunder. (*Journal of the Chemical Education, 25,* 272, 1948)

ON COAL ECONOMY

THE world consumption of coal is probably of the order of 1,200 million tons a year, from which supply 70 per cent of the world's energy requirements are generated. The *per capita* rate of energy consumption in the U. S. A. is more than five times the world average, 7,000 watts compared with 1,300 watts. In Great Britain, owing to increased efficiency in utilisation, at least four times as much useful energy is derived from a ton of coal as compared with two generations ago, but there is still room for much improvement.

The rate of heat release which can be obtained from a particular fuel depends upon (*a*) the preparation of coal, and (*b*) furnace and combustion chamber design. For example, the ash content can be reduced by cleaning, excessive swelling properties can be reduced by pre-oxidation, and the nature and proportion of volatile matter can be modified by low or high temperature carbonisation, and it is possible that the evolution of volatile matter during combustion can be modified by chemical means.

To come to practice, samples were taken of deposits in the boilers of 40 power stations. By relating the analysis of the physical and chemical properties of the deposits to the type of coal consumed and the combustion system in operation, it was possible to ascertain which types of coal were likely to cause least deposit and thus to increase the efficiency of each type of boiler and reduce the time it was out of action for cleaning. Smoke is due to incomplete combustion of coal and the conditions in which smoke is reduced to a minimum are specially difficult to secure when boilers are fired by hand. During the war it was necessary to reduce the smoke from hand fired boilers of ships in convoy and a smoke eliminator was devised which not only had the desired effect of reducing smoke, but also reduced the consumption of coal. The devise has been used with savings of up to 10 per cent on hand fired Lancashire boilers.

The effect of fuel consumption achieved by thermal insulation has so far taken place mainly on the basis of laboratory tests but large scale experiments are now being carried out on complete houses. The temperatures maintained in a group of experimental houses, with families living in them, are being measured by remote recording of instruments at a central station, with the object of determining the relation between fuel usage and the thermal conditions obtained. By carrying out a heat balance, it will be possible to measure the efficiency of the heating appliance, and the effect of the thermal insulation.

Researches are at present going on at the Ministry of Works to see how the new devices developed at the Fuel Research Station can be incorporated in dwellings designed to make the best use of the heat provided and to minimise the heat losses. Large economy can only take place by modifying existing equipment, and research is badly needed into methods of increasing the efficiency of ordinary domestic fires and into providing cheap means of increasing the insulation of the houses. The distribution of heat losses from a typical pre-war small house is roughly in percentages, external walls 28, window 12, ceiling and roof 15, ground floor 9.5, external doors 1.5, ventilation 30, hot water run to drain 4. Much could and should be done by insulating the various points of heat loss, but by far the easiest way to reduce loss of heat would be to adjust ventilation which accounts for 30 per cent total loss.

The fuel requirements of the industry are the product of the steel tonnage and fuel per ton of steel. The improvement of the latter figure has been going on slowly but steadily ever since steel making assumed its modern form around 1860. Nearly every stage from ore to finished steel products requires fuel, the latter stages of manufacture of some finer forms of steel taking more fuel per ton than the actual steel making. A recent full scale research on the Siemen's open hearth furnace showed that full use of existing instruments offered the possibility of reducing the time of a single cast by 10 to 20 per cent, with a corresponding reduction of fuel and that more exact control of the combustion conditions could reduce the fuel. (*The Advancement of Science, 5,* 46, 1948)

SULFA DRUG FOR CHOLERA

POSSIBLY future weapon against cholera, dysentery, and some other intestinal infections, phthalylsulfacetimide has saved lives of 97 out of 100.

A new sulfa drug that may be the weapon of the future against cholera, dysentery and some other intestinal infections was announced at the Congress of Tropical Medicine and Malaria meeting in Washing-

ton by Dr Harry Seneca, research associate at Columbia University College of Physicians and Surgeons

The drug is called phthalylsulfacetimide It was developed by Dr Seneca and Dr Edward Henderson, director of clinical research of Schering Corporation They were seeking a drug for dysentery and other similar infections that would be safe enough and cheap enough to be sold over the drug store counter like aspirin

When the cholera epidemic broke out in Egypt Dr Seneca flew to Egypt in October with a supply of the drug

Some 500 patients were treated Because of the chaotic conditions and lack of trained personnel, adequate records could be got on only 43 But of these 43, only one died That gives the new drug a record of saving lives at the rate of about 97 out of 100 in an epidemic in which almost 50 out of every 100 died The drug's success in cholera, Dr Seneca said, depends on its being given within the first three days of sickness

The drug has been given to patients in the New York area suffering from ulcerative colitis and from acute intestinal inflammation In the latter condition, some patients were relieved of symptoms in one day and all nine were cured on the fifth day Of the 28 ulcerative colitis patients, 18 improved when given the drug The drug is not expected to cure this condition, but to clear up secondary infection and give the ulcers a chance to heal

Success of the drug and its safety are believed due to its unique ability to penetrate the walls of the intestines without being absorbed into the blood stream It is given by mouth either in pills or in a powder dissolved in milk or water It is not yet on the market (*Science News Letter*, May 29, 1948)

FLIGHT TRAINING ON GROUND

PILOTS of the future, particularly those who handle giant passenger airplanes, will receive much of their training without leaving the ground This will be the training that has to do with operation techniques, and the ground-training is made possible by the development of a huge electronic-mechanical device in a model of a cockpit with all the hundreds of dials, levers, switches and controls which a pilot encounters in a plane

This device is called the Electronic Flight Simulator It reproduces in exact detail the flight deck or cockpit of the airplane whose performance it is designed to reproduce It incorporates all the existing aerodynamic data upon which the plane itself was produced Without leaving the ground, it can accurately simulate any condition of flight of which the plane itself is capable

The simulator was conceived and designed by Dr R C Dehmel of the Curtiss-Wright Corporation, with the co-operation of Boeing Aircraft Company It is a complete replica of the Boeing Stratocruiser-type giant transport cockpit The instruments and controls function precisely as in the real airplane The device has just been purchased by Pan American Airways, and will be used in pilot training for handling Pan American Stratocruisers Similar simulators can be built to aid in training for other planes

This flight simulator cost some $250,000 to build, and this does not include the cost of ten years of research work which preceded its actual construction It looks like a lot of money to put into one training device, but as a 'training plane' it can handle four times the number of flight and ground crews at a tenth the cost and in a fraction of the time involved in the use of an actual airplane

One important feature of this new flight simulator is that the entire operating crew, co-pilot, engineer and others, are trained at the same time An instructor behind them operates switches which activate the pilot's dials to indicate trouble with fuel flow, wrong oil pressure, carburettor icing, faulty spark plugs and other difficulties Pilot response is noted by him, and also the corrective action taken (*Science News Letter* May 22, 1848)

INTERNATIONAL DEPOT OF MICROSCOPIC PREPARATIONS OF CYTOLOGY

THE International Union of Biological Sciences, is the sponsor of the project of an International Depot of microscopic preparations of cytology, animal and vegetable The plan originally proposed by the late Prof V Gregoire could not be given effect to owing to the International situation, and the state of war

It is now proposed that the laboratory of Cytology of the Carnoy Institute, at Louvain (Belgium) would group together preparations obtained from numerous research centers, and having already been used as basis to previously published works Each worker, interested in a definite problem, could thus compare with his own documentation, the original microscopic documentation of other authors relative to the same matter It is hardly necessary to underline the considerable interest that a Depot of this kind, would acquire and also how much it would favour a good understanding amongst workers, and

would smooth out many difficulties and vain contestations, which are inclined to fill up scientific literature

But this result can only be obtained with the greatest comprehension and collaboration of the greatest number possible of cytologists L'I U B S invites them therefore, from now onwards to send their works to the Laboratory, and enclosed with them several preparations having already been used as basis to published works and to review such deposits in the future It is *desirable* that the spots considered by authors as particularly demonstrative or used as published illustration—should be specially noted on the preparations as clearly as possible It is also requested that a sample of the published work should be attached when sent

Every Biologist, known for his publications—and any other person, possessing an authorized recommendation—will be able to consult and study, as much as they like, all preparations which have been entrusted to the Depot, the consultants will have at their disposal, the Laboratory, necessary optical instruments etc All work must be done within the Depot, except if a written permission is granted by the depositor

The preparations will always remain the entire *property of the depositors*, who can at any time, have them sent back to them the cost of postage would then be paid by the administration of the Deposit

Prof P Martens, Director of J B Carnoy Institute, at Louvain (Belgium) will act as the Administrator of the Depot

METEOROLOGY IN RUSSIA

THE study of synoptic and climatic meteorology is energetically pursued in U S S R as evidenced from published reports slowly reaching this country A very thorough study of the overall climatic changes in Russia from 1760 to 1945 are brought out by E S Rubinshtein in an 83 page report entitled "K probleme izmenenija klimata", (Glavnoe Upraulenie Gidrometeorologicheskoi Sluzhby, Trudy, Nauchno-issledovatelski kh Vchrez hdenii, Leningrad-Moscow, 1946) and by A Khrgian, "Russkie Sinoptiki XIX veka ikh ol V nauke", (Meteorologia i Gidrologia, Informatsionnyi Sbornik, 2 44-50, 1946) Various characteristics are considered such as mean temperature, pressure, precipitation, cloudiness, humidity, wind, etc, to determine whether there is any factual data showing a real change in climate or an apparent fluctuation around a mean value. By the use of "10-year-overlapping-means", time-graphs are drawn from records at places in Northern and Southern hemispheres and it is shown that for Arctic regions and in the Soviet Union a distinct general warming up was evident in the past 30 years Increased stability of circulation patterns in recent years as compared with the past was also discovered especially as recorded by persistence data for temperature in the North Atlantic and Greenland The article also outlines problems of future research and a discussion on the applications of statistical research to medium and long range forecasting, details of which are proposed to be dealt with by the first author in a subsequent publication Russia was one of the most advanced countries of the world in dealing with observational methods and climatology while synoptic discoveries were considerably suppressed That both these are now energetically pursued in the Soviet Union is a fact which will hearten all meteorologists in particular and scientists in general for the outer world will have the opportunity of knowing their secluded findings

S K G

N L BOR

DR N L Bor, the well-known authority on the taxonomy of India Grasses, is appointed Assistant Director, Royal Botanic Gardens, Kew (London) Dr Bor was a member of the Indian Forest service from 1921-46 and for sometime held the office of the Deputy Conservator of Forests, Assam and acted as Inspector-General of Forests, Government of India in 1939 Excepting the years 1937 42, when he was the Forest Botanist at the Indian Forest Research Institute, Dehradun, Dr Bor was actively connected with administrative office from 1931 till his retirement in 1946 He was the Political Officer of the Balipara Frontier, Assam (1931-34), Deputy Commissioner of Naga Hills (1935-37) and Chief Administrator, Burma Refugee Organization for the Evacution, Reconstruction and Rehabilitation on the North-East Frontier during world war II (1942-46)

In spite of these heavy responsibilities as an Administrative Officer, Dr Bor has a distinguished record by his contribution to Indian Botany and has published a large number of papers and books His monograph on "Gramineae" (Grasses of Assam) published in the 5th Volume of the *Flora of Assam* and Grasses of U P, published in the *Indian Forest Records* have considerably added to our knowledge of the Indian grasses He has also published a series of papers in the *Journal of Bombay Natural History Society*, on beautiful climbers and shrubs of India

Dr Bor has also contributed to the Ecology of Assam and Nilgiri Hills and as president, Botany section, Indian Science Congress at Baroda (1942) he

spoke on 'Ecology Theory and Practice' Earlier, he obtained his doctorate for a thesis on the "Synecology of the Naga Hills" Since his retirement, from India, Dr Bor has made a detailed study of the Indian species of *Poa*, and describing new species from various parts of India

Dr Bor was awarded the *Paul Johannes Bruhl Memorial Medal* by the Royal Asiatic Society of Bengal in 1943 for the most outstanding botanical investigations carried out in Asia since 1938 He was elected President, India Botanical Society for the year 1945

Dr Bor is a fellow of the Linnean Society of London, Royal Society of Edinburgh, and National Institute of Sciences of India He was made a C I E in 1945

CHITTARANJAN *SEVASADAN* CANCER INSTITUTE

THE foundation stone of a Cancer Institute, to be attached to the Chittaranjan *Sevasadan*, a women's hospital in Calcutta, was laid by Dr B C Roy, Premier and Minister-in-Charge of Health of West Bengal on June 5 last

Laying the foundation stone, Dr Roy referred to the sacrifice made by the great leader late *Deshbandhu* C R Das in whose memory the Institute was to be named The Institute will be equipped with the latest apparatus for the treatment of cancer either by radium, deep X-rays or operation and will be the only one of its kind in India The X-ray apparatus will include a million-volt projector and it will be one of the eight such machines existing in the world today The hospital will be stocked with 1,000 milligrams of radium being the gift of a Calcutta business magnate. The Institute will undertake research into the treatment of cancer by experts who are now undergoing specialised training at New York Memorial Hospital, Stockholm Radiumhamlet, and London Royal Free Cancer Hospital

Inviting Dr Roy to lay the foundation stone, Dr Subodh Mitra on behalf of the Committee of Management of the Institute, said that since the establishment of the Chittaranjan *Sevasadan* in 1926, special attention had been given to the cancer cases in the hospital Dr Mitra claimed that 95 cancer cases were cured at the *Sevasadan*, an achievement not duplicated elsewhere in India 75 per cent of the patients admitted hereafter will be treated free of charge

Continuing Dr Mitra said that recent statistical enquiry although very inadequate showed that roughly a million people were suffering from this disease in India and that arrangements for treatment were very little

A total sum of Rs 30,00,000 will be required for building and equipment of the Institute, of which one-third have been raised and for the balance they have approached for a subvention from the Governments of India and West Bengal and the public

THE DAMODAR VALLEY CORPORATION

THE establishment of The Damodar Valley Corporation as announced earlier (See *Science and Culture, 13*, 246 and 288) came into formal existence in Calcutta from July 7 last 'The Damodar Valley Corporation Act, 1948' also came into force with immediate effect

Sri S N Mazumdar, I C S, of the Bihar cadre and who was until recently the Administrator of the project is appointed Chairman of the Corporation, with Sri P P Verma, Member, Indian Constituent Assembly and Prof B C Guha, Editor, SCIENCE AND CULTURE and Sir Rashbehary Ghosh Professor of Applied Chemistry, Calcutta University as Members According to the act, the Chairman and Members will hold office for five years

The headquarters of the Corporation is now at the Anderson House, Alipore, Calcutta, but it will be shifted to some convenient place in the Damodar Valley in Bihar as soon as possible

Dr Sudhir Sen (See *Science and Culture, 13*, 385) and Sri N R Chakravorty are appointed as Secretary and Financial Adviser to the Corporation respectively They will hold office for three years It is estimated that the construction of the dams on the Damodar and its tributaries will take seven to ten years

ANNOUNCEMENTS

Dr S L Hora, Director, Zoological Survey of India, has been appointed Honorary Member of the Staff of the Botanic Gardens, Buitenzorg, in recognition of his contribution to Tropical Zoology

Dr Panchanon Maheshwari, Professor of Botany, and Head of the Department of Biology, Dacca University, has been elected a corresponding member of the Botanical Society of America and an Honorary Foreign member of the American Academy of Arts and Sciences

Sri N N Chatterjee, head of the Department of Geology, Calcutta University will represent the *Geological, Mining and Metallurgical Society of India* at the Eighteenth International Geological Congress to be held at London from August 25 to September 1, 1948

Dr B S Guha, Director of the Anthropological Survey will represent India at the forthcoming session of the International Congress of Anthropological and Ethnological Sciences to be held in Brussels from August 15 next as announced earlier

Dr Gyan Chand, late of the Indian Educational Service and Professor of Economics, in Patna College, has been appointed Officer on Special duty, in connection with the working out of the details of the Proposed Planning Commission which was announced as part of the Government's industrial policy in the Constituent Assembly in April last

BOOK REVIEWS

Modern Magnetism—By L F Bates, Second Edition, 1948 (Cambridge University Press)

The appearance of the revised second edition of Professor Bates' book on Magnetism will be welcome by all experimental workers in this line, as well as by the students who would like to have a clear idea of the modern developments of the subject, shorn of abstruse quantum mechanical expositions The book does not claim to be a complete review of all experimental works up to date, which the interested reader may refer to a few other books which have recently come out The book also gives very valuable references to original works and papers which are interspersed throughout the book The real value of the book lies in the fact that though it contains a good collection of experimental data, the reader never loses sight of the theoretical aspect of the subject which these data go to support In the first few chapters both the experimental as well as the theoretical are treated in a very lucid and elegant manner The latter portions contain mainly the descriptions of the experimental works done by different workers and the results obtained therein The theoretical treatments are mostly too brief and sketchy, but inspite of it the discussions very lucidly brings out the physical ideas related with the topic Every chapter of the old edition has been suitably revised in the light of modern developments, wherever it was possible to do so without introducing discontinuity in the subject matter Of the six entirely new chapters added the last three deal with entirely new problems which of late have acquired a great deal of interest They could conveniently be treated in detail in a supplementary volume The Chapters XI-XIII and most of the additional notes on Pp 424-426 might have been more suitably incorporated in earlier chapters This would have given us a better mode of assessing the value of the modern theory of magnetism in respect of the experimental results both old and new Of course, we admit this would have meant writing an entirely new book as Prof Stoner had to do in the case of the revised edition of his celebrated book This, however, we think would have been worth while, coming from Prof Bates

Due to this unwillingness of the author to plunge into a new attempt aiming at a full exposition of the whole subject, the readers are liable to stumble somewhat in going through the book Sometimes also it becomes rather difficult to keep the link between expositions in earlier chapters and the more modern experimental results described later For example, certain amount of confusion arises (p 49) when, dealing with the crystalline electric field in para-magnetics, the author is still constrained to think in terms of a Curie-Weiss' Law in analogy to ferromagnetics above Curie temperature, as indicating the part played by the crystalline electric field Indeed such a law has no significance for the ordinary paramagnetics and should be altogether avoided It may perhaps also confuse a student somewhat if he finds it stated (p 47) that interchange interaction is commonly responsible for orbital quenching in most of the salts of the iron groups, or again that the orbital momenta are separately quenched even though the Russell-Saunders coupling remains intact, or again spin momenta are not affected by electrostatic fields (even leaving aside second order effects this is not true) Much of the existing confusion in the exposition of the theory of para-magnetism in the existing literatures has been clarified by the work of single crystals, of the Indian School of Magnetism at Calcutta and some more details of this work might have been profitably included in the book

In most cases the formulae have merely been stated without even an indication as to how they are deduced At least in some of these cases the theoretical deductions should have been given at greater length to the benefit of a good number of readers For instance, Heisenberg's theory of Ferromagnetism deserved some more space and Becker's theory of Magnetostriction processes and its relation to Weiss constant, In a few places

figures are not given, some times these cause a good deal of difficulty in following the experiments described, e g, Ochsenfeld's experiment described on p 258, Chapter VIII

A list of symbols used in different chapters with their significance would also be of much use

However, inspite of a few such shortcomings the book will be invaluable for all research workers and students in the subject, for its new mode of approach to the subject and for the inclusion of such matter which are not available in other books

A B & P K C

An Introduction to Electrochemistry—By Samuel Glasstone D Van Nostrand Company Inc New York Second printing, 1946, Pp vi + 557 Price 31/6*s* net

It is rather difficult to realise the scope of this book, neither supplementing nor superceding the author's standard book on the Electro-chemistry of Solutions, and therefore the arguments in favour of the book given in the preface do not appear convincing An Introduction to any branch of science should develop the fundamentals more than the details This Introduction does not satisfy this criterion to the desired extent It must, however, be admitted that the summarising of our present knowledge of some of the subjects dealt with in the book has been done in the masterly way of the author In several chapters or sections, a lack of balanced treatment of the subject matter has become prominent For instance, the value amplifier circuit for e m measurements could be discussed in greater detail than the method of Poggendorff The experimental results on the thermal properties of strong electrolytes have not been discussed consistent with the mathematical treatment

The problems given at the end of each chapter are instructive and no doubt a welcome feature

A number of lapses and apparently confused statements have been noticed Some of them require mention

P 144, line 10, para 3 $\log f_{+} = -Az + \sqrt{\mu}$ and $\log f_{-} = -Az = \sqrt{\mu}$ instead of the z's being squared

P 161, section on Triple ions The words 'increases' and 'decreases' should interchange

P 179 In finding the value of $\left(\frac{\delta\, G_{el}}{\delta T}\right)_{p}$ in equation, 125), it is not only sufficient to remember that K (kappa) involves $T^{-\frac{1}{2}}$ but also $V^{-\frac{1}{2}}$ and $D^{-\frac{1}{2}}$

P 196 A confusion is possible by the use of the word 'transfer' of matter in describing the process occurring in a cell without transference. In the sentence beginning after eqn (5), it is possibly meant that the removal is of *one mole* of hydrochloric acid

P 273 C_{V_0} + and $C_{V_0^+_2}$ should interchange positions, or the signs preceding the logarithmic terms reversed

P 385 The volume V_1 and V_2 should be in litres

P 404, line 4 from bottom The statement made does not follow as a logical consequence of what has been said above

Several other obvious mistakes appear on pages 19, 150, 178, 206, 324, 325, 362, 433

S. K M

Modern Cereal Chemistry—By D W Kent-Jones and A J Amos Published by the Northern Publishing Co Ltd, Liverpool, England, 1947, pp 651 Price 50 *sh* net

This book represents the pain staking efforts on the part of the authors to include almost conclusively upto-date information regarding the science of cereal chemistry in a comparatively small volume The book can be as much useful to a research worker, because of its valuable data and a number of references, as to a chemist ignorant of even the basic principles of biological sciences, for such concepts are explained in an unassuming manner by the authors

The cereals dealt with include Wheat, Barley, Rye, Oats, Maize, Rice, Soya and Potato the last being included due to its similarity to other cereals and its rare use as cereals All the cereals are considered from the viewpoint of their microscopic appearance, anatomy, chemical composition, the percentage composition of the various constituents therein and role of different ingredients in determining the quality and the consequent suitability of the grains for their use for various purposes The common constituents of cereals are moisture, carbohydrate, protein, fat mineral matters in varying proportions in different cereals, the actual percentage composition as well as the quality of the components being very much dependent on the conditions of growth and also affected by the conditioning process and the thermal treatment

Barley is used principally either for malting in connection with the brewing and distilling industries or for stock-feeding For a chemist the acid test of a good barley is the chemical composition of the grain and in general it may be stated that starchy grain is characterised, as in wheat, by low and steady grain by a high protein content In the production of malting barley a grain of good starch content is

always aimed at For the production of beer, the brewer is unable to utilise the carbohydrate matter of barley in the form in which it exists in the barley corn and so it must be first converted into malt by the process of germination or 'malting' when morphological, histological and various metabolic changes to get with the formation and liberation of enzymes take place The starch and branny skins of any cereal exhibit certain distinctive features under the microscope and the cereal or the cereals from which a milled product has been prepared can, therefore, be determined by microscopic examinations In the case of rye-flours it is impossible to wash out gluten-a gliadin glutemin complex as can be done in wheat flours The characteristics of oat flour are (*i*) its high fat content, (*ii*) providing a better balanced ration, (*iii*) presence of an anti-oxidant and its use to retard rancidification of oils and fatty products, (*iv*) lack of phytase causing rickets The principal protein in maize is zein which yields no tryptophane or lysine and hence possesses low biological value

Yellow maize is a useful source of carotene Milled rice prepared from parboiled rice (*i e* unhusked rice steped in water, treated with steam and dried) is richer in Vit B_1 than ordinary milled rice Almost all the Vit B_1 content of rice is concentrated in the bran Soya products are used in the manufacture of confectionery, bread, bakery products, invalid foods, ice creams, chocolate, and sauces and are also utilised in the paint, paper and plastic industries

The data for composition of soya beans shows that they have a high nutritive value being rich in protein of high biological value, rich in oil and phosphatides as lecithin and contain useful minerals which have an alkaline balance and are useful source of Vit A Potato solids are similar to flour solids in carbohydrate content and the replacement of a moderate proportion of flour by potato-solids will not so reduce the calorific value of the bread Such an addition improves slightly the liveliness of the dough and extends the life of the loaf by retarding the progress of staling Potato-flesh even at its natural moisture content of 75 per cent is very rich in Vit B_1, B_2 and even Vit C, which is not present in wheaten flour.

Wheat is a grain of special importance as it is most widespread The present day milling technique aims at effecting a clean separation as far as possible, of endorsperm from the outer husks and germ. After extraction of the flour the residue left called 'offal' is used for feeding live stock The dough is a mass of starch and protein particles covered by thin films of water The protein gluten forms a complex colloidal system. For the dough of any wheaten flour there exists a definite *p*H which will produce the best bread Dough is an example of redox system and during alcoholic fermentation redox potential changes All these physico-chemical aspects of flour determine the quality of the bread made therefrom and have been investigated to a great extent The flour and water do not yield merely a plastic mass, as do other cereals when mixed with water, but form a complex dough having elastic properties, which are distinctive of this cereal The gluten absorbs about twice its weight of water and the starch takes up about 30 per cent of its weight of water In general, this accounts for about 80 per cent of the added water and the remaining 20 per cent is held in the free state in the dough by capillary attractions In baking the dough is kept warm at 80°F and the yeast then proceeds to ferment the sugars pre-existing in the flour Further sugar-supply is provided by the diastatic enzymes of the flour which have been continuously producing maltose and other fermentable material since the dough was made In consequence of its nature this dough is able to hold the majority of the gas generated within it Diastase of flour consists of α-amylase, β-amylase together with activators and inhibitors β-amylase converts available starch into maltose and α-amylase produces dextrin responsible for the glaze of the bread Both flour and yeast contains protein and their action is important in dough ripening The proteolytic enzymes of flour are present in a latent form and become active only when stimulated by reducing substances of the nature of glytathione existing in the flour Phytase, an enzyme acting on phytic acid and important in calcium metabolism is also present Acid producing factors in dough are (*i*) CO_2 produced by the yeast, (*ii*) Acid phosphate salts by the action of phytase on phytin, (*iii*) Organic acids, chiefly lactic and acetic by the yeast and other organisms Several instruments are now devised for the measurements, of various characteristics of the dough which work chiefly on the principle of the measurement of the strain produced by the application of some stress For example, the amount of gas produced during fermentation is measured by the change in volume of a liquid at constant pressure or by the change in pressure at constant volume Automatic recording of gas production and other characteristics has also been accomplished A strong wheat is one which yields flour capable of making large loaves having a texture of a certain silky and finely vesiculated nature, for this efficient gas producing and gas retaining capacity is required The relationship between the flour strength defined as above on the one hand and the viscosity and elasticity of a dough, the quality and the quantity of the gluten, fat and lipoid content of the flour, and the behaviour of flour proteins when digested with various salt solu-

tions, on the other, is clearly brought out by the investigations of various chemists Before milling 'conditioning' i e treatment of wheat grain with moisture and usually also with heat is necessary, as wheat is then in a suitable condition for grinding One of the best checks on milling practice is the ash test The ash of pure endosperm is probably in the region of 0 30 per cent while the ash of pure husk is about 8 9 per cent By determining the ash content of a certain flour an idea of the percentage of husk present can be obtained The degree of granularity of a flour affects baking quality and there are methods available to determine the size of flour particle

The science of microbiology has a special significance in cereal chemistry as yeast causes and helps the panary fermentation and bacteria acts as a source of destruction Moisture in cereals is present in two distinct states Firstly usual moisture, which has but little influence on the chemical composition of the wheat or flour, secondly a possible moisture of constitution, which is much more closely bound to the flour When driven off it may cause a profound alteration in the character and constitution of the flour Moisture testing is very important There are many methods for this and for the determination of mineral matters and vitamin contents in cereals

The other uses to which the cereals can be put are described in the chapters on "Balanced rations for live-stock" and "Wheat for special purposes" The chapter on "The assay of Vitamin content of cereals and cereal products" have added much to the importance of this volume especially to the analytical chemist and bio-chemists

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B D R

LETTERS TO THE EDITOR

[The Editors are not responsible for the views expressed in the letters]

EFFECTS OF LIGHT AND WEATHER ON THE INVERSION OF SUCROSE IN THE SUGARCANES

THE action of inversion of sucrose in the sugarcanes when they stand on their roots as well as when they are cut off from their roots, has been studied, at the Bahadurgurh Farm, Patiala for the last two years The effects of the weather, thermal rays, light rays and ultra-violet rays have also been examined Some of the important results are

(*a*) The percentage of sucrose decreases from bottom to top of the sugarcanes and the inversion takes place first at the bottom and then proceeds on to the top of the sugarcanes which stand on their roots in the fields

(*b*) The inversion takes place at one time throughout the whole cane which is cut off from its roots

(*c*) The percentage of sucrose in the canes standing on their roots increases as the time elapses provided the weather conditions are favourable But the percentage of sucrose decreases in the canes which are cut off from their roots, with time, unless the weather conditions are favourable

(*d*) The inversion sets in the canes immediately after they are cut off from their roots, unless the weather conditions are favourable

(*e*) High temperature ripens the canes very rapidly and accelerates inversion, while low temperature retards it, irrespective of the canes standing on its roots or cut off from its roots

(*f*) Darkness reduces the action of inversion while the thermal rays, light rays, and ultra-violet rays accelerate it

(*g*) High humidity has very little effect on the action of inversion but it increases the percentage of juice in the canes

(*h*) Rain retards the action of inversion by lowering the temperature of the surrounding air, lowers the percentage of sucrose in the canes, increases the percentage of juice and encourages the growth of the canes standing on their roots

(*i*) In order to avoid or retard the action of inversion in the canes, it is essential that the cut off canes should be stored in a dark

place having low temperature (less than 60°F) and high humidity (more than 70 per cent)

The above results, especially the last one, are encouraging and valuable It is hoped that they will prove useful to all those who grow sugarcanes in their farms and crush them in their factories for *gur* or sugar

The details of this paper will be published elsewhere

Thanks are due to His Highness the Maharajadhiraj Mahendar Bahadur of Patiala, for providing all kinds of facilities to conduct this work at His Highness' Farm, Bahadurgurh (Patiala)

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NUTRITIVE VALUE OF *VANASPATIS*—3

KEHAR and CHANDA[1] pointed out that the utilisation of dietary calcium and prosphorus was adversely affected when vanaspatis were incorporated in a fat free basal ration of rats Effect of vanaspatis on the calcification of rat bones is presented here

Female rats in the early stages of pregnancy were removed to a dark room The youngs were weaned after 28 days and equitably divided into groups During the whole period of experiment, the animals were kept in dark-room The ration fed to animals and the procedure adopted was the same as described by Kehar and Chanda[2] in studying the effect of vanaspatis on protein metabolism The daily consumption of diet per rat was about 6-8 gms In addition, they also received carotene and calciferol supplements as in the previous experiment

After feeding the experimental rations for four weeks (the source of fat being indicated in the table below) the rats were killed and the fat free *femur* was analysed for bone ash The average results of bone ash of six animals are given in the following table

Source of fat	Weight of fat-free bone	Bone ash percent
Cow ghee	0 2334	63 1
Hydrogenated ground nut oil—		
(a) Dalda m.p 40-42°C	0·2199	57 4
(b) First quality m p 40-42°C	0 2247	56 3
Hydrogenated Sesame oil—		
(a) Temple	0 2204	54 6
(b) Rajhans	0 2303	54 0
Hydrogenated cotton seed oil—		
(a) Kotogem	0·2147	55·0
(b) Binaula	0 2395	53 4

It will be observed that as compared to cow ghee group, the bone ash of animals was less by 10 per cent when rats were fed with vanaspatis (Dalda and First quality) prepared from groundnut oil and 12 per cent when vanaspatis of sesame oil (Temple and Rajhans) or of cotton seed oil (kotogem and Binaula) were incorporated in the diet

Details will be published shortly elsewhere

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[1] Kehar, N D, and Chanda, R, SCIENCE AND CULTURE, 14 33, 1948
[2] Kehar, N D, and Chanda, R, SCIENCE AND CULTURE, 13 426, 1948

THE KOLHAN SERIES—IRON ORE SERIES BOUNDARY TO THE WEST AND S W OF CHAIBASA BIHAR

THE sedimentaries to the south, west and north of Chaibasa were all regarded by Dunn as belonging to the Iron-ore series[1] Later, he recognised the existence in South Singhbhum of a distinct formation, *viz*, the Kolhan series, younger than the Iron-ore series and the Singhbhum granite[2,3] The Kolhan series consists of a basal sandstone-conglomerate, overlaid by local limestone and these by shales Dunn observed that the main Kolhan basin of South Singhbhum extends southwards from Chaibasa at the northern limit of the basin The eastern boundary of this basin, against Singhbhum granite and Iron-ore series rocks was mapped by him from south of Chaibasa to beyond Noamundi, but the western boundary was considered uncertain[4] Between undoubted Kolhan rocks to the east (mostly shales) and undoubted Iron-ore series rocks to the west, again mostly shales, a tract of country presents difficulty in precisely mapping the boundary, as pointed out by Dunn[5]

The area immediately to the west of Chaibasa town was referred as an 'anomalous area'[6] Here a small thickness of "fine sandstones, shales and slates, and dolomite lithologically utterly different from the adjacent Kolhan rocks", was found to overlie altered lavaschists, and phyllite (which belong to the Iron-ore series) The stratigraphic correlation of these rocks thus becomes problematic

Intensive study of this 'anomalous area' by the present author shows that the sandstone, shale, dolomite, do not overlie the Iron-ore series, but are inter-

bedded with rocks of this age (Fig 1) The dolomite is really a lenticular bed, underlain by a thin shale, about 3′—4′ thick and then by a quartzite sandstone, 2′—4′ thick The dolomite dips west and is

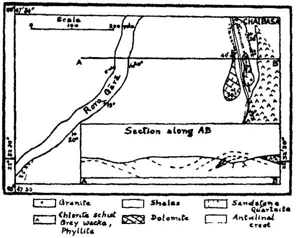

FIG 1 Sketch map of the so-called 'anomalous area'

overlaid by shales which continue westwards These form the western limb of a north-pitching anticline The quartzitic sandstone below the dolomite curves round to the north and is exposed as a thin band of quartzite in shales on the eastern limb of the anticline These shales on the eastern limb are overlain by chlorite-schists and schistose greywackes which are undoubtedly of Iron-ore series age These latter rocks are not exposed on the western limb and presumably, they thin out towards west The 'anomalous beds' must therefore belong to the Iron-ore series

Shales similar to those of the 'anomalous beds' with interbedded sandstones and quartzites, and occasional pockety deposits of massive dolomite, cover a large area to the west and S W of Chaibasa These areas are mapped as Iron-ore series The uncertainties in the evidence stated above are due to

(i) Paucity of suitable exposures , (ii) Similarity between the rocks of the two series as regards direction of dip, and apparently in lithological characters too , (iii) Absence of clear structural boundaries, such as thrusts , (iv) Resemblance, in particular, of certain Iron-ore series sandstones and quartzites in this tract to Kolhan sandstone

Inspite of the above difficulties, there is yet certain lithologic distinctiveness in each series, which is revealed in closer study —

(i) The pockety deposits of massive dolomitic limestone, as at Putada, W of Chaibasa, on the Gumua river etc offer a reliable evidence of the age of associated doubtful sandstones and shales These magnesian limestones are sharply distinct from the non-magnesian, phyllitic, low-dipping, cleaved limestones of Kolhan age, as noted also by Dunn ,[7] (ii) Schistose greywackes and chlorite-schists are found in typical Iron-ore series rocks, but not in the Kolhans , (iii) The Iron-ore series shales are commonly well-jointed, grey to yellow , while typical Kolhan shales are ill-jointed, and are mauve to buff in colour , (iv) The grey and white arkosic sandstones intercalated within the Iron-one series, are so far unknown within the Kolhan shales

Looking at a different angle, certain distinctions are also noticeable in the heavy mineral composition of the Kolhan and the Iron-ore series rocks

(a) Mauve zircon and actionlite are present in the Iron-ore series, but are absent from the Kolhans

(b) Tourmaline is much more abundant in the Kolhans

(c) Garnet and epidote, occasional in the Iron-ore series, are altogether absent from the Kolhans

Heavy minerals of the controversial rocks along the Gumua, S of Nimdih (just S of Chaibasa town) and near Lupungutu (22° 32′ 85° 47′) gave heavy crops similar to those of the Iron-ore series

Lastly, rocks of doubtful affinities, intruded by granite, must be regarded as Iron-ore series in age Kolhan sandstones, just S E of Chaibasa, overline Singhbhum granite with an erosion unconformity Granite sills of the Gumua, the Roro etc , only 2 miles away, cannot but be considered as belonging to the Singhbhum granite , besides, no Post-Kolhan granite has been recognized in Singhbhum so far So rocks intruded by granites presumably belong to the Iron-ore series

The boundary (Fig 2), as drawn here, is marked by evidences of faulting at most places, as shown by

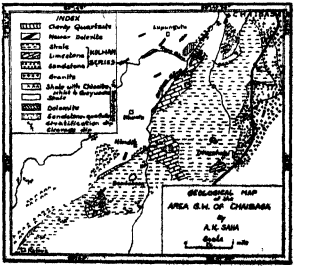

FIG. 2

the presence of cherty quartzite, which has been proved elsewhere to be due to silicification along fault zones (also noted by Dunn[8]), and the occurrence of sheared sandstones and quartzites, particularly along the Gumua

I am deeply indebted to Prof S K Ray of Presidency College, Calcutta, under whose guidance the work has been carried out

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Calcutta, 31-3-1948

[1, 2, 3] Dunn, J A - *Mem Geol Surv Ind*, *54*, Pl 17, 1929, *Rec Geol Surv Ind* 74(1) 27-28, 1939, *Mem Geol Surv Ind* *63*(3), 1940
[4] Dunn, J A and Dey, A K—*Mem Geol Surv Ind* *69*(2), Pl 40, 1942
[5, 6, 7, 8] Dunn, J A —*Op Cit* *63*(3), 369, 1940, *Ibid*, 361 362 1940, *Ibid* 362, 1940, *Op Cit*, *54*, 25, 1929

size too much It should then be sieved and −10 to +50 mesh particles collected, and roasted in absence of air, preferably in saggers at a temperature between 700 to 1000°C, cooled and washed with water and finally dried

Thus treated, graphite will not stick to the surface of the heating vessels, and will not fly off during setting up and removal of apparatus

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16-4-1948

[1] Harber, *Industrial & Engineering Chemisty*, Anal Ed *13*, 429, 1941
[2] Lasser-Cohn, Organic Laboratory Methods, 1928

GRAPHITE HEATING BATHS

During the last World War, when metals used in low-melting alloy baths for heating in laboratories were scarce, attempts were made to use graphite as a substitute for these alloys Similar investigations have been reported by Harber[1] and Lasser-Cohn[2] The advantages of using graphite as a substitute for alloys in heating baths are

(*a*) Temperature can be very easily maintained constant and if a thin layer of graphite is used, the rate of heating will be fairly high

(*b*) Being solid, it can be heaped over heating vessels to cover exposed surface to some extent When alloy-bath is used, big container and large quantity of material is necessary to attain the same end

(*c*) If proper grade of graphite is selected, any temperature upto 500°C can be easily attained and maintained with insignificant loss of material by prolonged use

Various grades of graphite from different parts of India and abroad have been tried, and Madagascar graphite was found to be the best The nearest approach to this grade are crystalline Indian graphite from East Godavari, Patna State and Travancore Graphite before use should be treated as follows —

Small lumps of graphite should be crushed in a roller mill or a burr-stone mill to separate individual flakes as far as possible, without reducing the particle

DEPOLARISATION OF SCATTERED LIGHT BY SHELLAC SOLUTIONS

THE true nature of shellac solutions has been a subject of some controversy The tendency of shellac solution to form gel at higher concentrations and the rapid increase in viscosity of the solution containing more than 25 per cent shellac have been explained by Gardner[1] and Verman[2] on the assumption of colloidal nature of shellac solution Palit,[3] however, has assumed them to be non-colloidal since they rapidly dialyse, pass through ultrafilters easily and are devoid of any Tyndall effect An interesting method of study reported in the present note is the determination of the degree of depolarisation of scattered light which may be utilised to obtain information regarding the nature of the dissolved units As compared with other techniques, the particular advantage of this method is that the three factors may be investigated simultaneously and their changes may readily be followed quantitatively

The degree of depolarisation is used to denote the ratio of the intensity of the horizontal component to that of the vertical component of the transversely scattered light According to Mie[4] the degree of depolarisation with incident light unpolarised (ρ_u) equals zero for spherical isotropic particles As the size and/or anisotropy increase ρ_u also increases Subba Ramiah[5] and Krishnan[6] have shown that the measurement of depolarisation with incident light vertically (ρ_v) and horizontally (ρ_h) polarised can give a clearer indication Thus a finite value of ρ_v is a definite indication of non-sphericity or optical aniso-

tropy only, while a value of ρ_n nearly equal to but necessarily less than unity would indicate an appreciable size whereas small values of ρ_n in the neighbourhood and zero would be an indication of anisotropy Intermediate values of ρ_n are determined by the joint influence of size and anisotropy

The results of depolarisation measurements by Cornu's method with alcoholic solutions of shellac are summarised in table I

TABLE I

% of shellac	ρ_h	ρ_v	ρ_n
5	0 5390	0 3334	0 5171
10	0 4924	0 2948	0 5063
15	0 4781	0 2756	0 4970
20	0 4459	0 2596	0 4933
25		0 2482	0 4885
30	0 3948	0 2474	0 4711
40	0 3857	0 2428	0 4611
50	0 3632	0 2393	0 4474
60	0 3486	0 2390	0 4143
70	0 3472	0 2387	0 4003

The very first observation that can be made from the above table is that ρ_n has got an intermediate value between 0 and 1, signifying that the depolarisation is due to the finite size and the anisotropic shape of the scattering units That the scattering units are anisotropic is also clearly evident from the value of $\rho_v > 0$ But this conclusion as to the finite size of the scattering units would appear rather perplexing for in the first place no stable colloidal micelle could be detected below 20 per cent shellac concentration, secondly shellac molecules are short compared to the wave length of light, and thus scattering cannot be ascribed either to colloidal micelle or to individual molecule This anomaly, however, may be explained by assuming the existence of relatively large but loose molecular clusters, i e, cybotactic groups, as has been done by Krishnan to account for the finite value of ρ_n for certain binary liquid mixtures Secondly, it is evident that with the increase in concentration of shellac, ρ_v gradually falls, signifying a decrease in anisotropy, i e, the clusters become more and more spherical

Measurements were done with other solvents and mixed solvents, and it was found that the results were similar to that of ethyl alcoholic solution There was no abrupt change in depolarisation factor at the gel point, signifying that gelation was not accompanied with sudden increase in particle shape or size

Best thanks are due to Dr P K Bose, Director, Indian Lac Research Institute, for his keen interest and to Dr J Gupta, University College of Science and Technology, Calcutta for the loan of the D P I. used in the present work

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19-4-1948

[1] Gardner *Ind Eng Chem Anal Ed*, *1* 205, 1929
[2] Verman, Technical Paper No 11 of London Shellac Research Bureau
[3] Palit, S, *J Ind Chem Soc* *17*, 537, 1940
[4] Mie, *Ann d Phys*, 25 337, 1908
[5] Subba Ramiah, *Proc Ind Acad Sci* *1* 709, 1934
[6] Krishnan, *ibid* *1* 211, 1934

ON CLEANING AND PRESERVATION OF BRONZE ANTIQUITIES

MUSEUMS all over the world frequently receive bronze antiquities of various types In India, metal images have been extensively used for religious purposes Wide choice of metals was made for the manufacture of these images An alloy popularly known to have contained eight metals (*Astadhatu* rendered in English by late Dr N K Bhattasali as octo-alloy) came to be largely used in eastern India The alloy is chiefly formed of copper and tin and is found to have all the qualities of bronze Usually these antiquities pass into the museums in extremely corroded state, deep green incrustation commonly known as patina formed by oxidation of copper is found covering the images Till recently this coating had not been considered injurious to the antiquities and the colour effect was appreciated for its aesthetic appeal Observations have shown that if the patina is not removed in time the form and texture of the antiquities get impaired beyond control by corrosion The usual practice with most of the museums is to get the antiquities cleaned by replacing the patina by a coating of thin varnish to act as a preservative For cleaning bronze antiquities different chemicals are used in laboratories A solution of 2% caustic soda, (NaOH) have been found efficacious [1] In the Asutosh Museum laboratory we have been experimenting with a solution of ammonium chloride (NH_4Cl), stannous chloride ($SnCl_2$) and dilute hydrochloric acid (HCl) for the last seven years with satisfactory results [2]

Recently three bronze images from Orissa have been treated by three different processes Of these two are of standing *Gopala* and the third one represents a *nayika*, belonging to the 16-17th century A D

The incrustation was removed with the help of stannous chloride, ammonium chloride and hydrochloride acid solution The image was immersed in hot water after each application of the solution used Finally a thin coating of linseed oil was applied for preservation

First the image was kept covered with cotton swab soaked in kerosene oil for 72 hours, then rubbed with finely powdered brick dust The incrustation having been removed a thin coating of linseed oil was applied

The third one was treated with the object of preserving the green patination so much appreciated for its effect The superimposed crust was removed by rubbing with wire brush, but a thin layer of green incrustation was left on the surface of the image After a day a thin coating of linseed oil was applied

The time required for cleaning and preserving the specimens was (1) 4 days in two weeks, (2) 3 days in two weeks, (3) 2 days in two weeks

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Calcutta University,
28-4-1948

[1] Vernon, W H J and Whitby, L, Open air corrosion of copper, *Jour Inst Metals*, 42 181-82, 1929
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THE HYDRATION OF EXCHANGEABLE CATIONS OF CLAY MINERALS AND SYNTHETIC RESINS

The position of the exchangeable cations in clay minerals in relation to their crystalline nature has been largely clarified by means of electrochemical and other physical chemical studies So far as exchange reactions are concerned, different levels of binding of these cations with the clay minerals have been envisaged [1,2] Moisture determinations coupled with chemical analysis and base exchange measurements have enabled us to conclude that the exchangeable cations, including hydrogen, of ovendry clay minerals are present in a hydrated condition

When the clay minerals are converted into their respective hydrogen systems the whole (or a part) of the exchangeable cations is replaced by hydrogen ions The original unconverted clay mineral on ignition of the ovendry material will lose a certain amount of moisture as a result of the expulsion of the OH groups present The oven-dry hydrogen system will evidently lose a larger amount under such conditions as a result of the hydrogen combining with the oxygen of the lattice From the base exchange capacity of the clay mineral the proportion of exchangeable hydrogen and consequently the contribution of the latter to the moisture loss can be calculated The observed moisture loss is found to be greater than that calculated by assuming the exchangeable hydrogen to be present as H^+, but a close agreement is obtained if H^+ is assumed to be hydrated as H_3O^+

The above arguments strictly apply to those minerals whose lattice structure, particularly in relation to the exchangeable cations, are well defined Muscovite mica suits best on these considerations From the observed base exchange capacity (b e c 26 m e per 100 g) of mica $(KAl_2(OH)_2Si_3AlO_{10})$ the amount of hydrogen mica formed by the usual procedure of leaching with dilute hydrochloric acid can be calculated on the assumption that by such leaching the potassium ion is replaced by the hydrogen ion The moisture losses of the hydrogen mica would be either 4 80 per cent or 5 25 per cent according as the hydrogen ion is present as H^+ or H_3O^+ The experimental mean value is $5\ 32 \pm 0\ 20$ per cent, so that the hydrogen ion is more likely to be present as H_3O^+

Montmorillonite has a variable structure and since the exchangeable hydrogen or other cations enter as a result of isomorphous replacement and balancing of charge, calculations similar to mica cannot be unequivocally made in this case However, an average molecular weight of montmorillonite can be calculated from a knowledge of the moisture content, assuming an average value of $x = 0\ 33$ in the molecular formula of montmorillonite $(Al_{2-x}Mg_x)Si_4O_{10}(OH)_2$ with xH^+ or xH_3O^+, as given by Ross and Hendricks' Knowing x (= 0 33), the b e c (= 110 m e per 100 g) and the moisture content of the hydrogen montmorillonite, the moisture loss due to the expulsion of lattice OH groups can be calculated and hence the molecular weight of the mineral, since one molecule of it corresponds to 18 gms of OH-water According as the exchangeable hydrogen is present as H_3O^+ or H^+ the molecular weight is calculated to be 338 0 or 247 0 From the formula the corresponding values are 365 6 and 359 6 respectively The calculated value on the assumption of H_3O^+ is thus much closer to the theoretical and the difference between the two calculated values is in sharp contrast to that between the theoretical ones

Clay salts are generally prepared by adding equivalent amounts of alkali to the hydrogen system,

so that the resulting colloid is completely saturated with the cation of the added alkali The moisture losses on ignition of even dry clay salts are found to be higher than that can be accounted for by the OH-groups of the clay minerals It is therefore concluded that the cations replace the H_3O^+ ions of the hydrogen systems in their hydrated forms The degree of hydration is found to be of the same order as generally observed in other systems Moreover, in the different over-dry minerals a cation is present in almost the same degree of hydration

A synthetic cation exchange resin formed by the action of formaldehyde on resorcinol in the presence of an acid catalyst has been found by one of us (S L G) to have a mean exchange capacity of 1242 m e per 100 g of the oven-dry hydrogen resin under a favourable and optimum set of conditions The theoretical value of such a H-resin (i e, without assuming hydrogen to be hydrated) can be calculated to be about 1560 m e per 100 g Under no conditions a value as high as the theoretical could be approached If, however, the exchangeable hydrogen of the hydrogen resin is assumed to be present at H_3O^{+4} as in the case of hydrogen minerals (i e, as H_3O—resin), the b e c of the corresponding H_3O-resin becomes equal to 1220 m e, a value much closer to the observed ones

The moisture and b e c determinations have been made with extreme caution and the results (expressed on the basis of ignited minerals) have been verified by three or more reproducible measurements Details will shortly be published elsewhere

Our thanks are due to Dr S K Mukherjee, of of the Department of Applied Chemistry, Calcutta University for his kind interest in the work and for giving full laboratory facilities

A K GANGULI
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University College of Science and Technology, Calcutta, 29-4-1948

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ON THE CATHODO-LUMINESCENCE SPECTRA OF INDIAN CALCITE DOLOMITE AND ARAGONITE

INVESTIGATIONS on the cathodo-luminescence of calcites were carried out by Tanaka[1] and Yoshimura,[1] and of dolomites and aragonites by Tanaka[1] who observed that the luminescence was due to rare-earths contained in them

Presence of rare-earths in Indian calcite, dolomite and aragonite, however, could not be detected by the authors by arc spectrographic analysis, carried out at 10 amps, 220 volts with E_1 Quartz spectrograph An attempt was then made to determine the rare-earths in these minerals which were effective as activators for cathodo-luminescence The method of excitation of the specimens in the tube was the same as that used in the previous investigation on Indian fluorites[2] Each of the specimens of calcite, dolomite and aragonite was powdered and heated for 10 minutes in a muffle furnace at nearly 800°C-1000°C This ignited specimen was exposed to cathode rays in the tube just after the heat treatment and the current in the tube was kept at 4-5 mA, 4000 V being applied Direct vision spectrograph, and Fuess Quartz spectrograph were used for taking spectrograms both in the visible and the ultra-violet regions, the time of exposure being 3-10 minutes for different specimens The identification of the line-like bands in the luminescence spectra of the specimens, observed under a 'Comparator' of nearly 10 times magnification, was carried out referring to Urbain's data for the different system of rare-earth oxide in calcium oxide ($R_2O_3 - CaO$)

TABLE I

COLOUR OF LUMINESCENCE OF CALCITE, DOLOMITE, ARAGONITE AND ACTIVATORS FOR LUMINESCENCE

No of specimen	Locality	Colour of luminescence	Activators of luminescence
Calcite			
PR 9609	Giridih	Yellowish white	Sm, Dy, (Eu), Mn
PR 9610	Udaipur	Greenish white	Sm, Dy, Eu, (Er)
Dolomite			
6115	Marble Rocks, Jubbulpore, C P	Yellowish white, violet tinge	Dy, (Sm), (Eu), Mn
6093	Nr Saiduwali, Salt Range, West Punjab	Yellow	Dy, Mn
Aragonite			
6679	24 Miles N W of Nokhundi, Baluchistan	Yellowish-white	Dy, Mn

Our best thanks are due to Prof M N Saha for his kind permission to use the Fuess Quartz spectrograph, to Dr A G Jingran and Mr G L Wakhaloo of the Geological Survey of India for

kindly supplying these minerals, and to the Director, Council of Scientific and Industrial Research for the grant-in-aid

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FIELD TRAINING IN GEOLOGY

THE mineral wealth of a country has a vital role to play in its industrialisation, and the renascent India has not been slow to place the need for development of its mineral resources in the position of priority in point of importance and urgency The Geological Survey of India, to cope with the ever-increasing volume and variety of its work has of late been in the process of rapid expansion The success of its programme, however, depends mainly upon the availability of suitable personnel

Apparently there is no dearth of men Recently for 14 posts of Geological Assistants for the Geological Survey of India there were as many as 170 applicants, consisting of B Sc 's and M Sc 's in Geology from different Universities of this country

The Geological Survey of India recently ran a training camp in the Central Provinces and Chota Nagpur for its new recruits Nearly a dozen post-graduate scholars of Geology also joined the training camp on the recommendation of their respective Universities The total number of trainees was 26, all holding high degrees of different Universities of this country During the period of training of nearly two months we, who were in charge of training them, had the opportunity of coming in close contact with the young geologists, and as such are in a position to make some observations regarding the scope and quality of their University attainments

We found the trainees, on the whole, quite well versed in the theoretical aspects of the geological science In the absence of a corresponding amount of work in the field their knowledge, however, was unbalanced and to a large extent ineffective In the initial period of the training it became obvious that most of the trainees, distinguished products of our Universities as they were, had yet to develop the right instincts of a field geologist Observation is the keynote of all Sciences, and this is specially true of a field science like Geology No amount of class room lectures and text-book studies can replace it Sound geological sense is born of hard and arduous outdoor work, without which book-learning is but dead matter clogging one's mind and blurring one's vision at every step in the practical application of one's knowledge

We do not for a moment mean to underrate the value and advantage of a thorough theoretical knowledge of the science to a student of Geology, but we feel that a considerable shifting of emphasis towards the practical field aspects, towards the application and utilisation of the knowledge acquired, is long overdue In most of our Universities the facility for field studies afforded to the students is extremely limited It appears that very little systematic geological mapping is undertaken, and in few Universities is any field instruction in topo-survey imparted It is our plea that only by studying the rocks as they occur in nature can the theoretical instruction received in the lecture hall and laboratory be properly appreciated

In the past when recruitment of our young graduates was confined to the subordinate positions in the Geological Survey of India, the initial deficiencies in their academic training would have ample time and opportunity to be adequately remedied during their period of tutelage under the experienced Senior Officers of the Department Only after some years of training in the Department would they have been considered fit to be entrusted with the independent execution of any responsible work

The conditions have changed Those unhurried days are gone The ever-increasing demand on the services of the Geological Survey of India and the accelerated tempo of its activities make the continuance of the old practice of slow departmental training impracticable

In these circumstances the responsibility of turning out scholars trained not only in theory but also in practical work, so as to be able to shoulder the responsibilities of independent work from the beginning of their professional career, devolves on the Universities It is known that the inadequate arrangement for the field training of the students in our Universities is not due to any indifference on the part of the Professors, but is directly traceable to lack of the necessary financial allotments for the purpose Implementation of any programme of systematic field training for the students involves expenditure, but since the funds are not forth-coming the Professors are forced to teach the students as best as they can

in the class room Sometimes again the Geology Department in the University is so badly understaffed that it cannot spare any of its Professors to take the boys out for field training for a period of any length

Our idea in writing this note is to impress upon the University authorities that if they really wish to qualify their students as true "Masters" of Science, which they call them, they must arrange for the imparting of the full and harmoniously integrated training on the subject to its votaries We hope and trust the authorities will take our suggestions in the same spirit in which they are offered, and will not grudge the investment considering the rich dividend it is sure to pay in the not very distant future

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SCIENCE AND CULTURE

A Monthly Journal of Natural and Cultural Sciences

Vol. 14 SEPTEMBER 1948 No 3

DEPARTMENT OF SCIENTIFIC RESEARCH—2

IN our previous editorial we have reviewed the growth in the activity of the Council of Scientific and Industrial Research and also discussed how far it could be fitted into the newly created Department of Scientific Research under the Prime Minister, which formed the subject of a recent Government communiqué In the present article we propose to discuss another paragraph of the communiqué which is given below

'The new Department will tender scientific advice to Governments, deal with *ad hoc* scientific research in universities and research institutions, research scholarship in applied scientific subjects, international scientific unions, scientific liaison officer, the scientific consultative committee and such other subjects as may be transferred to it

The department will co-ordinate the scientific activities of other Ministries and in the work will be assisted by a co-ordination committee consisting of eminent scientists '

A careful perusal has left the impression that Government have not quite made up their mind on the functions of this new Department and *the communiqué represents their thinking aloud* At a time when such important decisions are being made, a comparative study of how such problems are being dealt with in Great Britain and in the U S A may be helpful This article is written with this view and at the end certain suggestions are made on the government proposals

Research is a term with wide connotations and it is necessary to have a clear idea of the different kind of activities which are included in this word A very good classification of research activities is given in Steelman's Report from which we give the following extract

"Scientific research may be divided into the following broad categories

1 Basic research—(*a*) Fundamental research is research without specific ends It results in general knowledge and understanding of nature and its laws This general knowledge provides the means of answering a large number of important practical problems, though it may not give a specific solution to any one of them (*b*) Background research is the systematic observation, collection, organisation and presentation of facts, using known principles to reach objectives that are clearly defined before the research is undertaken, to provide a foundation for subsequent research or to provide standard reference data

2 Applied Research is the extension of basic data to the determination of generally accepted principles with a view to specific application generally involving the devising of a specified novel product process, technique or device

3 Development is the adaptation of research findings to experimental, demonstration, or clinical purposes, including the production and testing of models, devices, equipments, materials, procedures and processes It differs from applied research in that the work is done on products processes technique or devices that have been previously discovered or invented "

University Research —We have next to consider how these different research activities are distributed amongst the principal agencies interested in research *viz* Universities, Government and Industry For the discovery of new scientific principles and their utilisation by the State and Industry, it is necessary to impart to each new generation training in which Science is playing an increasingly important part, it is in educational institutions, including colleges, universities, technological and medical institutions, that such training in cultural and scientific disciplines are imparted In a constantly changing society, whose survival depends upon a rapid utilisation of new scientific discoveries for practical purposes of living, it is now generally accepted that at the University stage training in science must be intimately associated with training in methods by which new knowledge is acquired Further the consensus of opinion is, that fundamental researches in science should be associated principally with universities, at the same time it is recognized that other scientific institutions, Government agencies and industry are making increasing contributions to such fundamental discoveries.

Barring the recent intrusion of totalitarian reaction in certain powerful States, the long struggle for academic freedom has secured for universities of

the western countries protection from many of the immediate pressure of conventions or prejudices The university at its best provides the worker with a strong sense of group solidarity and security plus a substantial degree of personal and intellectual freedom Both are essential for the growth of new knowledge Speaking of university contribution to war research, Appleton's opinion is "One of the most striking results of wartime experience has been the brilliant success of our university research workers in solving war problems entirely remote from their peace time interests Various reasons have been advanced for this success It has been pointed out that they had fresh minds What cannot be doubted is, that University conditions certainly do somehow generally ensure the maintenance of mental adventureness and lively imagination so necessary for scientific progress"

The universities in this country are based upon western models and the principle of academic freedom has been taken over from them We have had so far not to struggle for it, and we hope that the time will not come when struggle for academic freedom becomes an actuality in this country also

Government research —A large amount of background research is carried out in Government departments and bureaus These include surveys and descriptions of basic facts and the determination of standards Applied research and development form an important part of Government sciences in several fields, such as agriculture and in various special industries where individual units are small and widely dispersed and where profit motives do not ensure the existence of adequate research and development

This work is in addition to the very large amount of research and development undertaken by all Governments for defence purposes In the U S A during 1947, out of a total sum of $625 m spent on national research and development, $500 m were spent on War and Navy and $125 m on civilian research Out of the former $100 m were spent in Government laboratories and $400 in university and industrial laboratories by contracts, while of the remaining $125 m, the proportion spent in Government and non-government laboratories were $100 m and $25 m respectively

Industrial research —In the U S A most of the important industrial companies maintain research laboratories, which have acquired deserved world-wide reputation for the fundamental and applied researches carried out in them The Government therefore do not actively undertake much research work on behalf of the industry, but give the industry aid in way of relief from taxation on expenditure incurred by industry on research and development, and in the operation of patent laws The relatively small scale of industrial production in Great Britain has necessitated in the Government undertaking a large amount of basic research in their own laboratories, and of applied research through those maintained by Research Associations Regarding the necessity of the latter, Appleton remarks, "In considering industrial research in Great Britain, we are at once faced with the fact that over 98 per cent of our firms employ less than hundred workers, so that although it is admitted that research always pays a dividend if you do enough of it, to a small firm without considerable financial reserves industrial research on its own account must often appear as a risky adventure and beyond its means This difficulty has been met to a considerable extent by the D S I R which is charged with the duty of encouraging research in industry

The main method by which we have done this is by the formation of research associations each on a co-operative basis to serve the needs of particular industries These research associations are self-governing bodies formed on a national basis, financed mainly by the contributions of their member firms, but supported by substantial grants from the DSIR, the size of which is related to the amounts raised by the industries themselves "

Rationalisation of Government research —We find that to an increasing extent science is being used as part basis for the formulation of Government policy, so that scientific knowledge is permeating every department In Great Britain the question has been raised, how far can a central scientific department serve these executive departments and how far should they be supplemented by scientific staff and scientific work within the executive departments themselves Two extreme views have been put forward , according to the one, all science should be made in a central scientific department and none in the executive, while the other view is that each executive department should have sufficient staff to make all the science it needs in the discharge of its responsibilities On grounds of economy, in Britain a large amount of common scientific service is provided to all departments Further it is proposed that each executive department should have a scientific adviser who can, (*a*) identify the problems in his department which are suitable for scientific treatment, (*b*) see that these problems are passed to the appropriate research bodies able to solve them and (*c*) interpret the incoming scientific material for the special purpose of his department (Appleton) Accordingly we find under the Lord President of the Council three departments of Scientific and Industrial Research, Agricultural Research and Medical Research But even then there are scientific experts responsible for defense, trade, food, health, transport and so on. It is interesting to note that in the book 'Science and

the Nation' brought out by the Association of Scientific Workers of Britain, proposals are made that each Ministry should have its own scientific service suitably strengthened to make it fully effective This would involve some Research Establishments at present responsible to the DSIR, or at least part of their work, being transferred to the appropriate Ministry of the Board of Trade, the Ministry of Fuel and Power, Works, Transport, Health etc At the same time background research such as that carried out in the National Physical Laboratory or general applied biological work may be kept under central control

In India under the Central Government, a variety of separate Departments and other bodies are responsible for research Meteorology is under Communication, Geological Survey is under Works, Mines and Powers, the Survey of India under Defense, Zoological and Botanical Surveys are under Agriculture, Medical research financed by Indian Research Fund Association, is under Health, Agricultural research is under Agriculture, Anthropology and Archaeology under Education, while the CSIR after being successively under several departments is now under the new department of Scientific Research A V Hill's proposal, which was referred in the previous article, is for the creation of a Central Organisation for Scientific Research, under which all government research, distributed amongst six boards, is to be concentrated The actual practical steps of development would be still under the different Ministries of the Central Government There would thus be a complete separation between basic research and development work Recent trend of opinion is against such a step Neither in the U S A nor in the USSR has such centralisation of Government scientific research been either effected or contemplated We shall consider how centralisation at policy level can be effected

This trend can be very well illustrated by considering the existing state of Government research in the USA and the steps which have either been taken recently or are still in the stage of legislation Previous to the last war, no formal effort had been made to coordinate government research which were carried out by the different State Departments, the principal ones being Agriculture, Army, Navy, Interior and Commerce

"The Federal Government is charged with primary responsibility for national defense, development of standards of weights and measures, control of interstate commerce, navigation and navigable waters, post offices and post roads —now extended to civil aviation—and the public domain, which includes reclamation and conservation' Research has been deemed a necessary adjunct to each of these In practice a broad view has been taken of the phases of our national life in which Federal Government has an important interest, health, education, recreation as well agriculture, to name only a few In some areas of research and development the national government maintains the primary research effort, *e g*, in atomic energy, weapons of war, survey and mapping In other fields it conducts experiments and other studies concurrent with similar efforts in the universities and industry, as in chemistry, geology and forestry Federal program and policy determination for scientific research and development are now *exclusively* the concern of various departments and agencies There is no focal point at which scientific policy of the government in general way may be formulated along consistent lines Entry by Government into many areas of scientific enquiry has been piecemeal and without adequate attention to other scientific and related activities Many of the complications of the situation were of recent origin" (Steelman, III)

It will be remembered how after USA's entry into the last war, decision was taken to set up a civilian research agency in the executive department under Dr Vannevar Bush for the duration of the war, which would be supplied with Federal funds to work on 'new instruments and instrumentalities of war' In July 1944, when the war in Europe was entering its last decisive stage, President Roosevelt appointed a committee with Dr Vannevar Bush as Chairman whose terms of reference included amongst others the following

"(3) What can government do now and in the near future to aid research activities by public and private organisations?

(4) Can an effective program be proposed for discovering and developing scientific talent in American youth, so that continuing future of scientific research may be assured on a level comparable to what has been done during the war?"

It was in Bush's report that the idea of a National Research Foundation was first broached, consisting of non-official scientists with an elected Chairman, which was to be entrusted with "the development and promotion of a national policy for scientific research and scientific education, the support of basic research in nonprofit organizations, development of scientific talent in American youth by means of scholarships and fellowships, with the support of long range research on military matter by means of contract or otherwise"

A number of bills were introduced in the Senate, for implementing the proposals of Vannevar Bush, of which bill S526, introduced by Senator Smith found the largest degree of support amongst the non-official scientists, and was passed in the Senate on 23-7-47 by an overwhelming majority We give below some of the important provisions of the bill

The Foundation was to consist of 24 members, to be appointed by the President by and with the advice and consent of the Senate

"The persons nominated for appointment as members shall be eminent in the fields of fundamental sciences, medical sciences, engineering, education or public affairs, and in making the nomination the President is to take into consideration recommendations of representative scientific and educational organizations An executive committee of nine is to be elected by the Foundation, from its own members."

The appointment of a Director of Foundation is provided in

Sec 6 The Foundation shall have a chief executive officer, who shall be known as the Director of the Foundation (hereinafter referred to as the "Director") The powers and duties of the Director shall be prescribed by the executive committee and shall be exercised and performed by him under the supervision of such committee

The powers and duties of the Foundation are defined in

Sec 4 (a) The Foundation is authorized and directed—

(1) to formulate, develop and establish a national policy for the promotion of basic research and education in the sciences,

(2) to initiate and support basic research in the mathematical, physical, medical, biological, engineering and other sciences, by making contracts or other arrangements (including grants, loans, and other forms of assistance) for the conduct of such basic scientific research,

(3) to initiate and support scientific research in connection with matters relating to the national defense by making contracts or other arrangements (including grants, loans and other forms of assistance) for the conduct of such scientific research,

(4) to grant scholarships and graduate fellowships in the mathematical, physical, medical, biological engineering, and other sciences,

(5) to foster the interchange of scientific information among scientists in the United States and foreign countries,

(7) to establish (A) a special commission on cancer research, (B) a special commission on heart and intravascular diseases, (C) a special commission on poliomyelitis and other degenerative diseases, and (D) such other special commissions as the Foundation may from time to time deem necessary for the purpose of this Act

The source of income of the Foundation is given under Appropriation

Sec 14 (a) To enable the Foundation to carry out its powers and duties, there is hereby authorized to be appropriated annually to the Foundation, out of any money in the Treasury not otherwise appropriated, such sums as may be necessary to carry out the provisions of this Act

(b) The funds hereafter appropriated to the Foundation, as herein authorized, shall, if obligated during the fiscal year for which appropriated, remain available for expenditure for four years following the expiration of the fiscal year for which appropriated After such four-year period the unexpended balances of appropriations shall be carried to the surplus fund and covered into the Treasury

The scientific activities of the Government departments are to be correlated by the appointment of an Interdepartmental Committee of Science

Sec 15 (a) There is hereby established an Interdepartmental Committee on Science, to consist of the Director of the Foundation, as Chairman, and the heads (or their designees) of such Government agencies engaged in or concerned with the support of scientific activity to a substantial degree as the President may from time to time determine The interdepartmental committee shall meet whenever the chairman so determines, but not less than once a month,

(b) The Interdepartmental Committee on Science shall gather and correlate data relating to the scientific research and scientific development activities of the Federal Government, and shall make such recommendations to the President, the Foundation, and other governmental agencies as in the opinion of the committee will serve to aid in effectuating the objectives of this Act, of other legislations providing for Federal support of scientific research and scientific development, and in preventing and eliminating unnecessary duplication of such activities by departments and agencies of the Federal Government

Some of the important general provisions given in Section 16 are

(h) In making contracts or other arrangements for scientific research, the Foundation shall utilise appropriations available therefor in such manner as will in its discretion best realize the objectives of (1) having the work performed by organizations, agencies and institutions, or individuals, including Government agencies, qualified by training and experience to achieve the results desired, (2) strengthening the research staffs of organizations, particularly non-profit organizations, in the States, Territories, possessions, and the District of Columbia, (3) aiding institutions, agencies, or organizations which if aided will advance basic research, and (4) encouraging independent research by individuals

(i) The activities of the Foundation shall be construed as supplementing and not superseding, curtailing, or limiting any of the functions or activities of other Government agencies (except the Office of Science Research and Development) authorized to engage in scientific research or scientific development

The proposals contained in the Bill, of controlling a large portion of the scientific activities of the State are on lines similar to those proposed by the National Institute of Sciences of India (SCIENCE AND CULTURE, February, 1944)

Such encroachment on the executive authority could not pass unchallenged, and on August 9, President Truman vetoed the Bill giving amongst others the following grounds

"This bill contains provisions which represent such a marked departure from sound principles for the administration of public affairs that I cannot give it my approval It would, in effect, vest the determination of vital national policies, the expenditure of large public funds, and administration of important governmental functions in a group of individuals who would be essentially private citizens The proposed National Science Foundation would be divorced from control by the people to an extent that implies a distinct lack of faith in democratic processes

Full governmental authority and responsibility would be placed in 24 part time officers, whom the President could not effectively hold responsible for proper administration Neither could the director be held responsible by the President, for he would be the appointee of the foundation and would be insulated from the President by two layers of part-time boards In the case of the divisions and special commissions, the lack of accountability would be even more aggravated

The ability of the President to meet his constitutional responsibility would be further impaired by the provisions of the bill which would establish an interdepartmental committee on science The members of this committee would be representatives of departments and agencies who are responsible to the President, but its chairman would be the director of the foundation It would be the duty of this committee to correlate data on all federal scientific research activities and to make recommendations to the President, to the foundation, and to the other departments and agencies of the Government concerning the performance of their functions in this field "

It has however been pointed out (*Chem and Eng News 25,* 2367, 1947) "At the present time another government research agency the National Advisory Committee for Areonautics with an administrative organization similar to the proposed science foundation is operating most successfully "

In the mean time the Steelman Committee, appointed by the President, in their report on Science and Public Policy, voiced the views of the government scientists and executives on this subject The main recommendations of the Committee have been summarized by them as follows

2 That heavier emphasis be placed upon basic research and upon medical research in our national research and development budget Expenditures for basic research should be quadrupled and those for health and medical research tripled in the next decade, while total research and development expenditures should be doubled

3 That the Federal Government support basic research in the universities and non profit research institutions at a progressively increasing rate, reaching an annual expenditure of at least $250 million in 1957

4 That a National Science Foundation be established to make grants in support of basic research, with a Director *appointed by and responsible* to the President The Director should be *advised* by a part time board of eminent scientists and educators, half to be drawn from outside the Federal Government and half from within it

5 That a Federal program of assistance to undergraduate and graduate students in the science be developed as an integral part of an over-all national scholarship and fellowship program

6 That a program of Federal assistance to universities and colleges be *developed* in the matters of laboratory facilities and scientific equipment as an integral part of a general program of aid to education

7 That a Federal Committee be established, composed of the directors of the principal Federal research establishments, to assist in the co-ordination and development of the Government's own research and development programs

Paras 4, 5, 6 contain recommendations on the support of non-governmental science, which are further amplified as follows

1 Develop sources of financial support for our colleges and universities to enable them to expand and improve their facilities and equipment, to increase their instructional staff, and to raise salaries This cannot be done for the physical and biological sciences alone, but only as a part of a general program The specific ways of accomplishing these objectives are now under study by the President's Commission on Higher Education But ways must be found

2 Develop a broad program for the support of basic research in the universities and colleges Basic research not only is of supreme importance to the whole development of science, but it is indispensable to the training of scientists As already outlined in the first report in this series—"Science and Public Policy—A Program for the Nation"—support of basic research should be extended by establishment of a National Science Foundation responsible to the President and a share of the money expended should be used to build up and strengthen the weaker but promising educational institutions

3 Develop a national system of scholarships and fellowships to continue Federal support of students as the benefits under the Servicemen's Readjustment Act expire Such a program should cover all fields of knowledge and not be restricted to the physical and biological sciences This matter has also been touched upon in the report, 'Science and Public Policy—A Program for the Nation", and is also under study by the President's Commission on Higher Education

While for coordinating Government scientific activities the following principles are laid down

The task of policy formulation for the Federal research and development program requires establishment of a number of co-ordinating centres within the executive branch of the Government These would be called upon to make determinations upon a number of interrelated problems, of which the most important are

1 An over all picture of the allocations of research and development functions among the Federal agencies, and the relative emphasis placed upon fields of research and development within the Federal Government must be available

2 A central point of liaison among the major research agencies to secure the maximum interchange of information, with respect to the content of research and development programs and with respect to administrative techniques, must be provided

3 There must be a single point close to the President at which the most significant problems created in the research and development program of the Nation as a whole can be brought into top policy discussions

Setting up an organization to handle these diverse functions is not a simple task that can be solved, for example, by establishment of a Department of Science Such an approach was considered in the course of these studies and, after consultation with scientists and administrators, was rejected

and the specific steps proposed are

1 An Interdepartmental Committee on Scientific Research and Development should be established by Executive Order

2 The Bureau of the Budget should set up a unit for reviewing Federal scientific research and development programs

3 A member of the White House Staff should be designated by the President for purposes of scientific liaison

In amplification of (1) it is recommended that an Interdepartmental Committee on Scientific Research and Development be appointed by the President and that its reports and recommendations should be made to him The group should consist of those bureau chiefs or other officials of the Government most deeply concerned with scientific research and development

The recommendations of the Steelman Committee on the Science Foundation entails a considerable restriction of the latter's status and responsibilities It becomes a minor committee consisting of an equal number of official and non-official scientists, with a Director appointed by the President and responsible to him The responsibility of coordinating the work of the Government scientific activities is taken away from it Its only function is to apportion grants from funds placed at its disposal for the furtherance of basic research

On the other hand improvement of science teaching and improvement of science laboratories, provision of science scholarships are recommended by the Committee to be included as part of an all round improvement of educational facilities which have been made the object of a special study by a President's Commission on Higher Education

The other important feature of the Steelman Report is on the coordination of Government Science and improvement in the mechanism of control and liaison with the President's Executive Office

The controversy between the President and the Legislature over Bill S 526 is still unresolved At the request of the former, the sponsors of the Bill, Senator Smith and Representative Wolverton, are meeting the President's nominees Dr Steelman and the Budget Director Webb, to work on the legislation until they agree on a bill that the President could sign As part of the compromise it is proposed to insert a provision in the bill whereby the President will be authorized to appoint a Director from the list of nominations submitted by the board of the Science Foundation

We have given in some detail the procedure which is being followed in the democratically governed U S A to hammer out an agreed policy on the National Science Foundation , the executive, the official and non-official scientists, and the legislature are all taking part in the discussion India, since August 15, 1947, is supposed to have become a secular democratic State , important decisions however are being taken on the Government's Science Policy, without the non-official scientists being given the opportunity to express their views

During the war Scientific Advisory Committee to the War Cabinet was set up in Great Britain under the Lord President of the Council who acts as its Chairman, with the President of the Royal Society deputising in his absence The Committee included equal numbers of official and non-official scientists Recently proposals have been made for the creation of a coordinating machinery between Government, university and industrial science by the addition of a Central Scientific Office at Cabinet level, as part of the office of the Lord President of Council This office should coordinate national scientific policy with the economic policy of the Government, and should be linked up with other planning agencies in the Cabinet offices and with the Central Statistical Office

It appears that due to different historical conditions in these two countries, the place of Science in relation to the State activities has been differently viewed in Great Britain and in U S A In the former the Universities were founded through unofficial agencies, which have collected sufficient endowments and secured grants from industries, individual firms and from civic authorities Only at a very late stage has the Government come forward with grants These come through the University Grants Committee of the Treasury, as well as through the different departments of research in Agriculture, Medicine, Science and Industry In the USA on the other hand though there are some richly endowed privately founded universities, there are also a large number of Land Grand Colleges and State Universities which are maintained by Federal and State grants It is therefore natural that aid for improvement of science teaching and training in research and award of scholarships and fellowships should be considered apart from the proposed Science Foundation and as part of the general problem of improvement of higher education and as such is being considered by a President's Committee for Higher Education

In India apart from fee income, the Universities and Colleges are maintained mainly by Federal and provincial grants Only a very few like the Hindu University, Benares, Muslim University, Aligarh have substantial endowments Even they receive large grants from the Centre and the United Provinces Consequently provision for better teaching and equipment and for normal university research activities (including training and research in Medicine and Technology) should come from a single agency in the Ministry of Education For this purpose a special section of the ministry with an adequate staff of scientists, technicians and educationists should be created The University Grants Committee, consisting of non-official educationists, will then act as an Advisory Body to this Ministry and not as in Great Britain be under the Treasury

Government research is more centralised in Great Britain than in the U S A. In the latter country the general policy adopted is that in each of the large executive departments, research and development should be associated together Better integration at the policy making level is secured by Interdepartmental Committees It is recognized that there has been a certain amount of overlapping of research by contracts *e g* , in atomic research etc , grants have been provided by different Executive Departments like the Army, Navy, and Atomic

Energy Commission Encouragement of industrial research is not an important problem in the U S A Government, support of basic research through a National Science Foundation is accepted by all shades of public opinion It is recognized that uptill recently applied research in the U S A has flourished by exploitation of fundamental discoveries, originating in Western Europe It is felt that in view of the chaotic conditions prevailing there, new sources of fundamental discoveries nearer home should be encouraged

Basic research in India, especially in those subjects which form the starting point for the development of instruments and machineries, which for good or evil, are shaping the destinies of nations cannot be carried out without the manufacture in this country of certain essential instruments and mechanical appliances We refer to nucleonics, electronics, radio engineering etc

Government aid of industrial research will also not be effective in this country, until industry becomes more research conscious At present industry is dominated by financiers with strongly developed profit motive It may take a couple of decade before the necessary change in their outlook takes place There will however be till then enough demand for background and applied research in Government scientific services, organisations, and Government sponsored industries

The time has however come for a decision, whether any further separation of research from development work along the lines contemplated in Hill's report should be encouraged, or whether the principle should be formulated that so far as possible, barring certain kinds of common background research, research and development pertaining to each executive department should be associated together The conditions have changed since Hill's report was published Many top ranking Indian scientists, whose number is very limited, are being recruited for the Government departments, and there is a danger that institutions of University status responsible for the training of the younger generation may suffer thereby There has been an unprecedented expansion of scientific and technological activities in the Government departments, research and development stations, Railways, Communication and Defense Large numbers are being recruited, after not very adequate training at home and abroad We hope that such expedients adopted to meet an extraordinary situation will not leave behind undesirable permanent consequences

Steps have been taken, we understand, to form interdepartmental committees of Government scientists, and any failure to support research and development in any one of the departments will attract the attention of this Committee and adequate measure will then no doubt follow

If the dictum is accepted that each executive department of the Government should as far as possible and necessary, be made self-sufficient for research and development, there will then be no need for a special Scientific Research Department for tendering scientific advice to other departments Further, either the three Councils of research in agriculture, medicine, science and industry be placed under one Ministry, like that of the Lord President of Council in Great Britain, or the C S I R should not come under the Scientific Research Department at all On the otherhand there is need for a Central Scientific Office at Cabinet level, similar to that proposed for Great Britain, for the coordination of national scientific policy with the economic policy of the Government, to be linked up with other planning agencies in the Cabinet offices and with the Central Statistical Office, when created The other activities of the proposed scientific research department *viz*, international unions etc may form part of the work of the Central Scientific Office

Whether the support of basic research and the grant of special fellowships and scholarships for pure and applied research should be undertaken by this Office, with an Advisory Committee of the nature of Science Foundation should also be considered

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PLANT QUARANTINE

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(*Continued from the last issue*)

THE PRACTICE OF PLANT QUARANTINE

We have seen elsewhere[1] that quarantine can be useful in preventing or delaying introduction of foreign pests or diseases, or limiting further spread of those which have already gotten introduced and established a foothold as well as those of the indigenous pests and diseases which are still confined in their distribution to few limited areas At the same time it is known that every plant part or product—be that fruit, seed, graft, tuber, bulb, etc ,—can, and in reality often does, act as the carrier of disease germs or the eggs, larvae, pupae or adults of pests So the only theoretical way to stop foreign pest and disease introductions, or to limit the spread of the indigenous ones is to prohibit completely by enactment of laws, trade in plant and plant products with all foreign countries as well as between different parts of the same country But such a course of action is impossible in practice It will lead to the adoption of a policy of extreme isolationist character so far as the rest of the world is concerned , within the country itself it shall severely strike at the root of free, regular and legitimate trade and much of social intercourse as well—a situation less tolerable than the plant pests and diseases themselves The reaction to such a programme of actions will lead also to retaliatory measures by the governments of the countries affected by such wholesale embargoes It will lead to jeopardize the whole economic situation, and agriculture, whose interest the aim of quarantine is to serve, will be no less impaired than any other economic phases So there arises the necessity of a compromise between what appears to be an ideal theoretical approach and what can be best achieved in practice with as much less interference as possible with legitimate trade and commerce commensurate with the direct economic benefit a quarantine is to achieve

INFORMATION ABOUT FOREIGN DISEASES REQUIRED

Having known the practical impossibility to adopt a course of action stopping all import of foreign agricultural commodities as would theoretically be called for to give complete protection to the country's agriculture against establishment of new pests and diseases, also having known what calamitous some of the introduced pests and diseases might ultimately prove to be, a course of action seems to be called for which will help prevent introduction of such veritable plagues with all means possible including embargo on importation in those few cases where no other means are considered effective Adoption of less stringent measures are called for for those pests and diseases which are likely not to be so destructive, while still lesser measures for those which have no more than a nuisance value

So to determine what types of quarantine actions are called for, a thorough study of the particular pest or disease must be undertaken before any one action is decided upon If the exigency of the situation so demands, trained and experienced workers should be sent abroad to study such pests and diseases in their natural habitats as has been practised by the United States Department of Agriculture in case of several of the foreign pests and diseases Countries beginning to adopt the science and practice of quarantine as an aid in plant protection should first find out what has been the country's normal commerce as regards importation of plant commodities—cereal and pulse grains, seeds and fruits, tubers, bulbs and other nursery stocks, logs and timber, unprocessed cotton and other fibres, oil seeds for crushing, tobacco leaves for cigarette manufacture, crushed oil-seed cakes for manure and a multitude of others too numerous to enumerate What are the countries from which they are normally being imported and what are the common diseases and pests from such commodities are known to suffer from in their land of origin, what seems to be the potential capacities of such pests and diseases to assume a destructive form in regard to country's agriculture in general or with reference to a particular crop or crops, should such an exotic pest or disease get introduced? Even what is a minor pest in a foreign country should not be lost sight of in such a study It might just be a minor pest there because of the absence from that locality of other preferred pests Such minor pest might assume epiptytotic proportion in a new country should it happen to cultivate widely such preferred hosts Colorado potato beetle has been an example belonging to this group

There are so many unknown factors which influence the behaviour and performance of lower lives-

[1] SCIENCE AND CULTURE, *14*, 48-53, 1948

fungi, bacteria and insects that they do not follow any hard and fast mathematical formulae Even a best brain and most conscientious worker may fail to predict their performance in a new territory Chestnut blight, walnut blight, citrus canker, Japanese beetle, citrophilous mealy bug, cottony cushion scale, pink boll-weevil have been some of the diseases and pests which have been of not much significance in their country of origin, but have proved devastative when established into the United States Others like European Dutch elm disease, late blight of potato, white pine blister rust, European corn borer, cotton boll-weevil, gypsy moth dreaded to become destructive if introduced, actually proved to be as apprehended when they entered in the United States While cases might be cited which, though likely to cause heavy damage if introduced into North American mainland, have fortunately fallen far short of their assumed destructive potentiality when they were found later to have already been established there

Though, as told above, it is not always possible with our present state of knowledge to predict with high degree of accuracy how a foreign disease will behave in a new territory, a working hypothesis can be adopted whereby diseases and pests of a country having similar conditions of temperature, humidity and precipitation can be viewed with greater apprehension than those originating in countries having altogether a different set of meteorological factors A disease or pest originating in a tropical country will have more changes to establish in India than those which are known to be limited in their distribution to temperate zones only With regard to borderline cases—which are neither strictly temperate nor tropical—the policy should be in favour of quarantine action only when it is a disease or pest of major economic importance attacking a number of crops, important to the area sought to be protected and or the quarantine operation would entail little expenditure and cause no economic disturbance

Survey of Domestic Pest and Disease Situation

Of equal or even greater importance is a thorough survey of the pest and disease situation of the country itself It is no use to spend much energy, time and money, and the antecedent inconvenience to which public might be put to in the enforcement of a quarantine, especially when it is of a prohibitive nature, only to find soon after that the pest or disease, which was sought to be prevented from being introduced, is already well established in the country Disease and pest survey must be an integral part of any quarantine organization In spite of the enactment of any quarantine barrier and best organizational set-up for its enforcement, pests and diseases may, and there are many cases on record where they actually did, evade many routine preventive and control operations The function of a disease and pest survey should be to keep strict vigilance, and to detect it as soon as possible For it is much easier to control or eradicate an incipient establishment over limited areas But once an intruder gets a securer foothold and becomes spread over wider areas before it is detected, it often becomes an impossible task to stamp out the pest or disease, and remains a source of constant trouble until the susceptible pest is completely wiped out or a biological equilibrium is established , or a suitable breed of resistant variety is available, if at all Prevention is admittedly the best way, but when a scourge has eluded the preventive quarantine barriers at the port of entrance, the next best is to have a supplementary detecting system effective enough to discover in the quickest possible time of any unfortunate establishment of new pest or disease Plant pest and disease surveys should, in other words, act as the watch-dog to announce the trespassing of an unfriendly intruder so that machinery for effectively dealing with the latter can be forthwith unleashed Survey operations are equally important also to keep in constant view the day to day situation of diseases and pests, indigenous to the country itself

Enactment of Quarantine Laws

Having seen that the case in question—a disease or pest requires quarantine action, and that the merit of the case satisfies all of the four biological and economic principles on which alone a quarantine is to be based, the next step is to enact a law by the duly constituted authority of the country Due publicity to such enactments should be given so that interested parties in the country or abroad are in possession of such information , for, the satisfactory working is no less dependent on the cooperation of the people and parties trading or otherwise dealing in plant commodities in question The wordings of the act should be in as clear terms as possible This will minimize reference to court of laws for the interpretation of ambiguous terms

Depending on how serious a pest or disease is viewed with, the specific quarantine measure will differ Quarantine laws may be passed for any of the following types of action depending upon the plant materials, the pests and the diseases involved

Prohibitive Quarantine (*Embargo*) —By prohibitive quarantine is meant the placing of an embargo against the importation of specific plant materials into the country because the entry of such plant materials would probably mean the introduction of their natural pests or diseases and the possibility of the establishment of such foreign pests or diseases

Embargo is the severest of all quarantine action possible and as much is made of against pest and disease which are reputed to be vertitable scourges in their native country and are likely to assume similar intensity if introduced, and against which no other easier method to deal with is known that will eliminate the risk inherent in the importation of such materials, or the pest or disease is of such a nature that it cannot be detected by the known, practical inspection methods Embargo is also a fit case to be employed in cases where no practical treatment is known to free the infected or infested plant materials, or where known the cost is to be of such an excessive nature that application of control measures will be beyond economical proportion

Detention —Classes of pests and diseases which are known to be less destructive and detection of whose presence can be ascertained in host materials sooner or later should be dealt with under this category Bulbs and nursery stocks especially might harbour deep inside the tissues of their body pathogenic fungi and bacteria or eggs, larvae, etc , of pests undetectable from outside by most careful examinations Fumigation or other treatment of the whole plant or bulb is mostly ineffective as the disinfectant cannot reach deep into the body of the plant materials where the pest or parasite is slumbering Therefore such classes of propagating materials should be grown in isolation in glass house over a reasonable period to see that they grow out free from obscure diseases and pests not detectable at the time offered for entry When freedom from infection is assured, the materials are ready for release

Growing in isolation in green houses, which are always limited in space, in itself puts a limit on the volume of materials that can be successfully handled Further, nursery stocks and bulbs are considered very ideal materials from the point of view of disease and pest introduction and establishment since a pest or disease is all the more likely to perpetuate when introduced in association with its living hosts than when introduced separately and independently of its host In the latter case chances are that the pest or the pathogen will die out before being able to find out its suitable host

Therefore it is almost an universal and recognized practice to discourage as much as possible importation by private parties of nursery stocks But, for the purpose of keeping the country supplied with new varieties and necessary propagative materials, or educational, experimental, or scientific purposes, such importations of propagating materials are often imperative , they are usually imported according to needs under government auspices, and are usually grown in detention in glass houses under supervision of competent plant pathologists and entomologists before being released to the public

Disinfection —Disinfection is usually prescribed as a condition for entry of imported plant parts or tree seeds meant for raising seedlings, products such as unmanufactured cotton, tobacco leaves, seed-cakes to be used as manure Disinfection is also applied as a blanket measure in many types of seeds, propagating materials, etc , which are usually known not to harbor any particular disease or pest, but which if ever present might evade eye examination , in other cases where because of the more apparent nature of lesion or other symptoms, eye examination can be relied upon, disinfection is still resorted to in practice when such materials are offered for entry in greater bulks, that individual examination is impossible, or when disinfection can be more economically done than visual examination

Disinfection is achieved through the application of chemical treatment in the form of steeping fluid or dusting as in the case of seeds , or fumigation under pressure with methyl bromide, etc , as in the case of cotton lint, tobacco leaves, seed-cakes , or hot water treatment for certain cereals, where the pathogen is known to lie dormant deep inside the grains, unable to be reached by any other means

Experiments at the Plant Introduction Garden of the United States Department of Agriculture at Glenn Dale, Maryland, have shown that perishables such as green lima beans, string beans, podded peas, sweet potatoes, grapes, peaches, and chestnuts as well as several hundred species of green-house plants can be successfully fumigated without injury with methyl bromide at doses sufficient to free them from thrips, mealy bugs, aphids, soft scales, white flies, and red spiders

Inspection —Inspection has a low rate of value in a quarantine scheme and is therefore applied in those cases of seeds and other plant materials, which are usually known not to hibernate diseases and pests and therefore involve less risk of disease or pest introduction and establishment But inspection has certain amount of value to see that plant commodities imported are free from other plant parts or refuse that are known to be carriers of important pests and diseases, that the seeds or nuts are free of dried up pulp and fibers, sand and soil, or that the packing box and other packing materials are free from any contamination Inspection will also be helpful to find out unusual chance association of a pest or disease with not too natural a host

Unrestricted Entry —The last of quarantine action or rather negative action lies in allowing free entry of plant materials Plant materials often not capable of use in propagation but imported for manufacture, medicinal or food purposes come under this class Seeds of vegetables, flowers and other annuals

and ornamentals, which due to their limited period of growth season involve less risk of pest and disease establishment. Even in the worst, should any disease or pest become established in such a host, no economic sequence will confront the nation except the loss of some aesthetic value in the unavailability of a particular kind of decorative flowers.

SUPPLEMENTARY ACTIVITIES

Certification and Permit.—Besides the above categories of quarantines, there are certain other actions that operate in supplement to the former. Under supplementary actions lies the regular or periodic inspection by competent members of quarantine service of nurseries that raise propogative stocks meant for sale, or orchards that grow fruits meant for inter-provincial shipment, and issuance of certificate of freedom from incriminated pests and diseases before they are allowed to move. Whatever it might be worth, most countries insist that each consignment of plant parts or products should be covered by certificate of pest and disease freedom in general, or against specific pest and diseases, and as to their origin in localities known to be free from such diseases and pests infestation, issued by responsible agricultural officer of the country of origin before it can be imported, subject to any further action such as growing in detention, disinfection, inspection as might be prescribed for any particular plant materials.

There are other plant materials that are considered more dangerous from the point of disease and pest introduction. Such materials can only be imported under specific permits issued by the officials of one's own country. These permit systems help keep track of the materials imported, should any contingency arise.

Channeling of Importation.—To further minimize risk of foreign pests and diseases being established, it is often an important practice to fix certain ports for the unloading of specific plant materials, say in the case of cotton and tobacco, it should be a safe practice to assign their entry to port or ports far away from locations where cotton and tobacco are grown as a major crop. Though under recognized quarantine practice these materials are allowed to move in bondage to fumigation house for necessary treatment before they are released to proceed inland, certain risks always remain that a few of the pests, or parasites, or infested materials may get disseminated however carefully the consignments are handled or under whatever guarded conditions they are transferred. The escaped organisms will have very much less chance of survival than had there been growing a crop of tobacco or cotton in the neighborhood.

Seasonal Importation.—All seasons of a year are not equally suitable for activity growth and multiplication of all pests or pathogenic organisms. Similar conditions exist for the host plants as well. Knowledge of such nature is utilized as an aid in minimizing risk of pest and disease introductions. Certain pests or pathogens that thrive on foliages only, will have much less chance of establishment if such importation is limited to a season when the host plants shed off their foliages. Conversely, during certain seasons the pest leaves the host plant to hibernate elsewhere (as in the case of the Japanese beetle). Movement of such plant materials can safely be done during such period. Similar measures hold good for dealing with materials that carry pest capable of infesting another seasonal crop by limiting importation during period when the latter is not in the field.

In certain other cases importation from one climatic zone to a different climatic zone can be done with lesser risks than when done between zones having identical climatic conditions at the same time of the year.

ORGANIZATION OF A QUARANTINE SET-UP

Enactment of a fine set of quarantine laws and regulations will not in themselves solve anything unless there are organized machineries to enforce them rigidly and honestly. Enforcement must be carried out rigidly because slackening in efforts at any one stage will upset the whole scheme. Pests and pathogens are constantly under the natural pressure of dispersal and have a hundred and one ways or avenues through which they are trying to gain entrance into a new territory. A slight weak point in this barricade will set at naught the value of the hundred other strongly guarded posts. Secondly, it should be carried out most honestly above personal prejudice or favor to anyone or party. Because the success of a quarantine depends ultimately on the spontaneous cooperation of the public, no amount of police action can detect or prevent completely the handling of contraband plant materials in contravention of quarantine laws and regulations. The public will submit less grudgingly to the inconvenience consequent upon a quarantine enforcement when he finds that the enforcement officials are at least honest in their dealings. When this honesty becomes coupled with a little courtesy on the part of the officials, a sympathetic attitude of the public will flow to the organization which cannot be earned otherwise. Simultaneous with this, a programme of

education of the public should be undertaken to acquaint them with the aims and objectives of quarantine actions A little money spent on such educative measures will ultimately pay in many fold when people learn that it is necessary for their own interest and the interest of their own country to abstain from activities which are in contravention of the quarantines in force Such awakening of a sense of duties will make it possible to enforce quarantines much more effectively than would otherwise be possible even with a much bigger body of enforcement personnel

The administration and enforcement of quarantine can be divided into the following broad activities barring intricate details

Maritime-port Inspection —Perhaps the most important function in the field of foreign quarantine is inspection of plant materials offered for entry into the country including luggage of passengers arriving from foreign lands Ship's store rooms, refrigerators, crewdecks and cargo-holds should be carefully inspected to see that they do not harbor any contraband materials or pests that might get over to the shore Depending on the nature of the contraband materials, the master of the ship may be asked to sign documents imposing on himself the responsibility that such materials be not handled while the ship is at pier, and guarded in such a manner as to leave no chance of such infested materials or the pests getting over to the shore, or that he destroys them in the presence of quarantine inspectors

As regards materials in passengers' luggage and cargo, any of the prescribed measures such as inspection and release, detention, and fumigation may be adopted While for materials the entry of which is prohibited, the shipper should be asked to reship the materials out of the country forthwith , failing, they should be destroyed under orders of superior quarantine officials

Fumigation House Quarantine Garden House —As an adjunt to maritime-port inspection is the availability of suitable fumigation house where materials that are prescribed fumigation as a condition of entry may be despatched for scheduled treatment Location of such a plant should be as near the piers as possible to minimize the risk of pests and diseases materials escaping in transit

Glass covered green houses are essential where doubtful cases should be grown in detention under competent supervision before they may be released Every progressive country feels the necessity of importing suitable varieties of crops from abroad for the purpose that their cultivation be adopted in the country, or with a view to use them in breeding or other scientific investigations Such purposes can only be fulfilled if and when such materials are introduced free of their pests and diseases But if pests and diseases are carried along with them, then such plants will not be of any economic advantage, but these carried-over pests and diseases might soon establish on some indigenous crops proving thereby more detrimental than beneficial Growing in quarantine glass-houses for a certain length of time and nothing freedom from pests and diseases is essential before their commercial propagation is advocated in any national programme of plant introduction

Airplane Traffic Inspection —Airplane traffic presents greater risks of entry and spread of dangerous foreign pests and diseases Pests and diseases that were in incipient stages of development at the start of a long journey in a steamboat would possibly have showed up visible symptoms by the time the cargo was presented for quarantine inspection or even would have met with natural death due to long sojourn under unnatural conditions But freshly gathered fruits, vegetables, etc , with incipient stages of infection will go undetected by the present day inspection method, will reach foreign countries within a few hours under aircraft transportation and will possibly be delivered along the air-routes in smaller markets, not far off from agricultural or orchard areas

Greater precaution should be taken when the airplane flight originates or resumes through places having a seasonal or otherwise pest infestation Such planes should be fumigated both inside and outside as soon as they land It should further be directed that such planes be also fumigated under supervision of responsible pest control officials of the foreign country before it takes off for the home port Action like the above are taken when plane lands in the United States territory from certain South American countries, and in certain seasons

Similar procedures are applicable in case of domestic air traffic when the flight originates or resumes through areas having a severe pest infestation

Transit Inspection —Under this falls the common-carriers such as railroads, vehicular traffic, moving plants or plant products from one province to another or from one part to another part of the same province It should be the duty of the transit inspection staff to see that contraband or other restricted materials do not move in violation of any quarantine in force from one territory to another Vigilance should be maintained at bigger railroad junctions through which most of the volume of materials pass as well as at important crossings along the national highways for vehicular inspection

Postal Inspection —Vigilance should be maintained that no live pests or disease producing organisms or contraband plant materials are imported, except as prescribed under rules, from foreign countries through the medium of postal services, or from one part of the country where the disease or pest is present to another part of the same country known to be free from such infestation Postmasters will have much co-operation to offer while inspection personnel will have to be located at bigger junction post offices of the country

Research Activities —No quarantine organization will be complete unless it has a good research set-up where workers are laboring patiently to find out more effective methods of inspection and detection, better fumigation and fungicidal treatments, to find out more facts about the nature, habits and life-histories of exotic as well as indigenous pests and pathogens so that they can be more profitably, effectively and efficiently handled than was so long possible *

* The author wishes to avail the opportunity to express his deep appreciations of the kind co-operation offered by the officials of the Bureau of Entomology and Plant Quarantine, U S Department of Agriculture, during his several visits to its headquarters at Washington, D C, and some of its field stations

Sincere thanks are due to Dr W A McCubbin, Senior Pathologist, Division of Domestic Plant Quarantine, for giving most ungrudgingly his valuable time and the benefit of his long experience in the field of plant quarantine in discussing many phases of quarantine activities and also for his kindly arranging itinerary of some of the visits

Lastly, the author is indebted to Dr J G Leach, Head of the Department of Plant Pathology and Bacteriology, West Virginia University, for his constant help, advice and encouragement and for his kindly discussing with and bringing to the attention of the author much information on different aspects of plant protection, quarantine and other regulatory activities Thanks are due to him for his aid in the preparation of the manuscript

OBITUARY

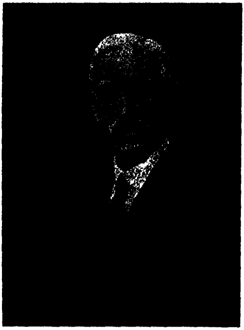
FREDERICK GOWLAND HOPKINS (1861—1947)

THE development of Biochemistry as an independent science during the last three decades or so, is to a large extent associated with the life and work of Frederick Gowland Hopkins, who passed away in 1947 at the age of 86 Here was a man who was apparently designed by Nature for science The impress of genius was on him Entirely new fields of biochemical research were opened by his work and it was characteristic of him that after opening the new paths he would often leave others to follow up the work while he himself proceeded to march into fresh fields of scientific adventure And yet while he was himself outstandingly original, both in his thought and in his methods of work, he was always appreciative of the laborious work, which must be put in by scientists in general in order to build up the main body of knowledge Once he said "Lucky wayfarers may come by nuggets of gold by the wayside but it is by systematic mining alone that the currency of nations is provided"

Hopkins lost his father when he was an infant His schooling did not proceed evenly At the age of 17 he had to enter a firm of Insurance Agents at the instance of his uncle This period, however, was short as his aptitude for science was discerned and Hopkins was sent as an apprentice in a private analytical laboratory At 20 Hopkins got a small inheritance and went for scientific training in the Royal School of Mines Then he became an assistant in the private laboratory of Dr P F Frankland This establishment soon closed down and Hopkins went in for the Fellowship of the Institute of Chemistry by examination He did so well that Dr Thomas Stevenson, the then Home Office Analyst, made him his assistant in Guy's Hospital Here Hopkins spent 5 years and learnt a lot He matriculated from the London University when he was 26 by carrying out his studies in the evenings Hopkins' placement in Guy's Hospital brought him in touch with medicine One of the medical students, (now Sir) Charles Martin, used to have talks with him in the laboratory where he worked and contacts of this nature seemed to incline Hopkins, who was so far trained essentially as a chemist, to turn more and more to Physiological Chemistry Hopkins, in fact, decided to take a medical training At the same time he went in for a B Sc degree which he took in 1890 getting Honours in Chemistry and Physiology and the gold medal in Chemistry In 1894 he took the M R C S and L R C P and the London M B degree He got his D Sc in 1900 This brief biography would show that Hopkins was a self-made man in the real sense of the term His training both in Chemistry and Medicine was turned to good account in making his outstanding contributions in Biochemistry in later years

Hopkins married in 1898 Miss Jessie Stevens, who was a real help-meet to him throughout his life and career

By 1898 Hopkins had already made considerable scientific reputation and Sir Michael Foster, the then Professor of Physiology in the Cambridge University invited Hopkins to initiate teaching and research in Physiological Chemistry In 1902 the Readership for Physiological Chemistry was created at Cambridge, as Hopkins by then had apparently convinced the University of the importance of such a subject In 1905 Hopkins was elected to the Fellowship of the Royal Society He was associated in Cambridge with the Emmanuel and Trinity Colleges In 1914 a Chair of Biochemistry was created at Cambridge for Hopkins and later as scientific honours came to him thick and fast, Hopkins got a new building through the bequest of Sir William Dunn



FREDERICK GOWLAND HOPKINS

The researches of Hopkins cover indeed a very wide field He always followed his bent At the early age of 17 he contributed a scientific letter to the *Entomologist* His earliest important work was on pigments of the wings of the butterfly From this work he was led to work on uric acid in metabolism He developed an accurate method for estimating uric acid in urine Then he published a paper with Garrod on urobilin where also his analytical powers were quite apparent At this time Hopkins began his important studies on proteins and described the crystallization of egg albumin An outstanding piece of work was the isolation of the amino-acid, tryptophan, from casein after enzymatic hydrolysis The story of the discovery of tryptophan is interesting On one occasion an entire class of students failed to perform the Adamkiewicz reaction for proteins which consisted in the production of a violet colour by the addition of dilute acetic acid followed by concentrated sulphuric acid The failure of the reaction was traced by Hopkins to the use of acetic acid and he showed that it was really the small quantities of glyoxylic acid which were present in ordinary acetic acid which actually gave the test Since this acid was absent from pure acetic acid the test had failed Since then it is called the glyoxylic test or the Hopkins-cole test for proteins It was characteristic of Hopkins that after finding the real conditions for the reaction he turned his attention to that group in the protein molecule with which glyoxylic acid reacts From this point he was led to the isolation of tryptophan in 1901, which has been mentioned above It also shows the originality of Hopkins that he sought to identify the new amino-acid by a novel method *viz*, by the identification of the products of its bacterial decomposition

Hopkins had always a stereoscopic view of Chemistry and Biology and this led him to investigate the importance of tryptophan in the diet It is from these studies that the "essential" nature of certain amino-acids came to be recognized These amino-acids cannot apparently be synthesized by the body and have to be supplied in the food

The next important work of Hopkins on an entirely different subject was in relation to the formation of lactic acid in muscle This classical paper under the joint authorship of Fletcher and Hopkins (1907) practically laid the foundation of modern developments in muscle biochemistry Some later workers followed up this work and made further fundamental contributions on this subject

In 1912 Hopkins published his work relating to the discovery of what we now call vitamins for which he was awarded the Nobel Prize in Physiology and Medicine in 1930 Although a few previous workers had got indications that a diet consisting exclusively of carbohydrates, proteins, fats and salts was unable to support life in young animals and requires to be supplemented by such materials as milk and eggs, it was Hopkins who by his well-controlled and quantitative experiments proved that milk contains a substance which is required by the body in relatively small quantities but is nonetheless essential for life and growth He had showed in this experiment with rats that the supplement of milk to the basal diet could not possibly make a difference between life and death by providing extra calories or proteins or salts but must contain some unknown substance in the absence of which the major food constituents could not be utilized by the body This was indeed a

fundamental discovery which has since revolutionized the whole science of nutrition and has moulded food policies and food habits in most countries, both in peace and in war Hopkins had made this discovery in the early years of the present century and as early as 1906 in addressing the Society of Public Analysts Hopkins referred to this work But Hopkins wished to publish his work only after he had isolated the active principle concerned So he postponed publication until 1912 Even then he was unable to isolate the factor concerned As we now know, there are a number of such substances and it is clear that the resultant effect on growth could only be obtained if all or some of these factors were simultaneously supplied During the World War I Hopkins tried to bring home the new science of nutrition to the British Government of the day in supplying food to the Army and the civilian population This was for a long time in a muddle owing to the new concepts of nutrition not having filtered into the minds of the powers that be

In 1921 Hopkins published another classical paper on the isolation of glutathione which was an autoxidizable constituent of the cell This has been the starting point of a series of researches in many countries Although the structure of glutathione as originally conceived by Hopkins was not correct, Hopkins re-investigated the problem at the instance of the work of Hunter and Eagles and isolated glutathione by a new elegant method which led to the determination of its correct structure

In 1923 Hopkins published another important paper on xanthine oxidase which is present in milk and oxidizes xanthine and hypoxanthine to uric acid

From 1939 onwards Hopkins was in failing health In spite of it he returned to his favourite study of butterfly pigments and published a paper on the pterins and their oxidation products He also began further work on glutathione and glyoxalase of which glutathione is a co-enzyme Hopkins published several other papers during this time on hypoxanthin and on refection in rats When it is remembered that all this work appeared when he was already above 80 it will be understood how research was dear to him A paper on glyoxalase appeared posthumously in 1947

The writer was very fortunate in having been in Professor Hopkins' laboratory for some time The impression he gathered was that Hopkins was great in more senses than one He was one of the greatest scientists of all ages being able to combine the general with the particular and imagination with accuracy He would never lose sight of the wood for the trees and yet he knew all the details of at least some of the trees While he encouraged all scientific work with the real affection of a teacher, he greatly valued originality and that freedom of mental gesture which sees new vistas Once the writer asked Professor Hopkins as to what he thought would be some of the outstanding contributions in Biochemistry in future He thought it would be in the direction of the interpretation of living phenomena in terms of atomic Physics and Chemistry Professor A Szent-Gyorgyi seems indeed to be moving in that direction Besides Hopkins' influence in the whole field of science which he exercised with a synthetic-*cum*-analytic mind he was particularly responsible for the development of Biochemistry as an independent discipline He was one of those leaders who put Biochemistry in the map He felt that unless Biochemistry left the leading strings of Physiology and Medicine it could not develop on fundamental lines although he all the time insisted on the value of the closest association of Biochemistry with all the other sister sciences

Hopkins was famous in the world of science He was the President of the Royal Society He got the Nobel Prize He got honours from both sides of the Atlantic and yet he wore all this glory with the greatest simplicity and modesty Those who have come in touch with him have loved him He was called by the endearing name "Hoppy" by all his pupils and colleagues in Cambridge Small in stature but great in mind and heart Hopkins powerfully influenced those who knew him through contact and through his work *

B C Guha

* The writer is indebted for some of the material in this note to the obituary notice by Miss M Stephenson appearing in a recent issue of the *Biochemical Journal*

ONE STORY OF RADAR*

THE story from the pen of A P Rowe, C B E who had been the war-time Chief Superintendent of Telecommunication Research Establishment (T R E), now finally located at Great Malvern, describes the stages of development of radar aids to the fighting forces of Great Britain from 1935 onwards The activity covers a span of nearly ten years The incentive to this work started since Hitler came into power in 1934 and an armed conflict with Germany seemed to be certain even to the most optimistic pacifists The menace was that of the bomber aeroplanes which Germany possessed in plenty, visiting England, particularly London, in hundreds, and dropping bomb-loads on crowded areas and essential factories and thus paralyzing the life and activity of the English people

The problem was to intercept these swarms of bombers and to shoot them down before they could do much mischief At the out-set of 1934, the military could think of no other alternatives than providing the big cities and factories with anti-aircraft guns and shooting down the planes as they came within the gun range or sending swarms of fighter planes to overtake the bombers and to destroy them The percentage of success by both these methods were very small

The method which was finally evolved and was destined not only to defeat the Bomber menace, but to carry the warfare to the heart of the enemy's country,—Radio Detection And Ranging or simply Radar, is now well-known This consists in sending by means of powerful transmitters, intermittent search-light of very short radio waves over the sky to distances of one hundred to two hundred miles and thus sweeping the sky by means of these waves If there is any hostile plane in the field of these radio waves, the radio energy reflected by these hostile planes are caught in the powerful receivers and transferred to the Cathode-ray Oscillograph where they appear as tiny, light spots Once the plane is caught on the oscillograph it can be kept automatically on the field and the motion of the plane can be followed, and by electronic arrangements guns are automatically directed on it Position of the plane is then just like that of a rat in a trap This is the simple story of radar The whole of Eastern and Southern coast of England was served by a chain of radar stations and in the later stages hardly any German plane could penetrate the border line The invention of Radar according to the scientific experts was the *third greatest discovery in warfare*, the other two being the discovery of gunpowder and that of the internal combustion engine

In 1934 however when the problem of interception and shooting of hostile planes first attracted the attention of the British Scientists, nobody could foresee this development Appleton has shown that the electromagnetic waves get reflected from the ionosphere and Breit and Tuve in U S A invented the pulse-technique—the method of sending powerful pulses of short duration vertically upwards to get reflected from the ionosphere and make its appearance on the field of the oscillograph Some scientists, particularly Watson Watt, thought that the same method could be used for getting reflection from hostile planes and thus detecting them much earlier before they could make their appearance on their targets An organization was set up to try this idea, on the recommendation of a committee presided over by Sir Henry Tizard in February, 1935, with a few assistants from the National Physical Laboratories under Watson Watt And their first station was at Orfordness, near Aldeburg in Suffolk A handful of men worked there to test the idea of application of radio detection and ranging and the results were encouraging so far as laboratory experiments were concerned But problems of finding accurate altitude of a plane, its accurate range, number of planes coming, or identification of friend or foe were still unsolved The solution of those and their actual application demanded expansion of the establishment which was accordingly transferred to Bawdsey, situated at mouth of river Deben

In May 1936 the Bawdsey Research Station was started The coastal radar chain, mentioned earlier and known as C H started from this place and the first of the many stations from Ventor to Firth of Tay was installed here A school was opened for training the R A F men Many of the old problems were solved here , many new problems appeared along with the progress of the work Identification of friend or foe (I F F) was found out As the C H could not detect the presence of aircraft flying at low level, a separate chain, known as C H L (Chain Home for Low flying) was formed by using a wavelength of 1½m In May 1938, Watson Watt became the first Director of Communication Developement at the Air Ministry and A P Rowe became the Superintendant of the Bawdsey Research Station By Good Friday 1939, the chain of radar stations guarding the coast of England was complete

As the research on radar progressed it was found that the efficiency of the technique called for lower

* 'ONE STORY OF RADAR' by A P Rowe, C B E Published by Cambridge University Press, with a foreward by Lord Tedder 8s 6d Pp 220, 7 plates, 1948

and lower ranges of wave-length The first experiment at Daventry was carried out at 50 m The wave-length was gradually reduced and the prospect appeared more hopeful New problems popped up in the process of the construction and production of these highly powerful ultra-short wave tubes Extensive researches for this production were carried out, which resulted in the invention of many new devices like Klystron and Magnetron which have ultimately opened new fields of research So long radar flood-lights were used to detect planes This implied that the radio waves from an aerial system was transmitted so as to flood the sky and any plane coming within the radar flooded area could be roughly detected By using shorter waves like 1½m, the aerial system became shorter enough to be rotated, on turntables and so form a radar search-light, which could now efficiently detect the presence of planes Before the high power Magnetrons (working on the cm band) were produced efficiently, nearly the whole of the work was performed on 1½ m Researches on this line were carried out at many other places like Birmingham (under M I E Oliphant) and at the Clarendon Laboratory (under J H F Griffiths) and at the laboratories of General Electric Company Vigorous works also went on to produce air-borne radar sets to help the fighter planes to locate enemy planes and to home on targets Care was also taken to give radar helps to the Navy Experiments on air-borne radars became quite successful at Bawdsey

With the outbreak of war in 1939, the responsibility of the organisation increased many times and the constant demand of effective radar aids for R A F, Navy and Army necessitated immediate expansion of the establishment with all its branches And the establishment was removed to Dundee

The original team of workers was not intact The new establishment was at first called The Dundee Research Station and then Air Ministry Research Establishment (A M R E) The place was not at all suitable for research work for many a reason, the chief of them being want of accommodation On May 5, 1940 the A M R E moved to Worth Matravers

At Worth Matravers the team of workers were reinforced by the arrival of many eminent physicists like A I Dee, R Cockburn, C Holt Smith, D Fry etc The progress was still very slow, because the persons who worked were nearly unknown to one another and a real team was still to be formed However the installation of Ground Controlled Interception (G C I) raised the morale of the workers and the servicemen using them As is well known G C I saved England from the incessant bombing of the German night bombers Another important invention that came in May, 1940, was the Plan Position Indicator (P P I) In the radar searchlight the radar beam rotated with the rotation of the aerial and, in alignment with it, a line from the centre of the radar oscillograph screen to its circumference rotated so as to sweep over the whole area of the tube about every 20 seconds This line was the range scale If the rotating beam encountered any plane a bright spot appeared on the rotating line The distance of the spot from the centre gave the range and, the angle made by the line passing through the spot and the centre of the screen with respect to some reference line gave the direction of the plane In the mean time it was found that for further efficiency of radar, radio waves of centimeter range or microwaves, as they are called, must be used And it was at Worth Matravers that the successful experiments on microwave radar was carried

By 1940 the A M R E took the name of Telecommunication Research Establishment (T R E) and was suddenly transferred to Swanage, most probably as a precautionary measure After coming to Swanage T R E grew up into a full-fledged applied research establishment with its own drawing office, with its own model shop and with its own attached airfield properly staffed to help the air researches It was at this place that the majority of the miraculous radar devices like Oboe, Gee, H_2S (Home Sweet Home) were born—the devices that saved England from German attacks by air and by sea

The technique of Air Interception (A I), considered to be the most difficult radar problem was evolved here Gee came into practice It laid down an invisible radio network of position lines over Western Europe and thus providing every bomber aircraft with its special radio set enabling the aircraft's position on this network to be determined The creator of many a miracle—Oboe—was a device which under certain condition enabled a bomb to be aimed with a high degree of accuracy in all conditions of visibility, by day or by night There were two ground stations known as the Cat and the Mouse The cat station enabled an aircraft carrying a special equipment to fly with great accuracy over a target The mouse station calculated the position at which the bomb should be released in order to hit the target and sent the release signal to the bomber Home Sweet Home is a device by which a bomber can by itself home on a target correctly All these devices were invented and immediately put into operation

The organisation consisted now of 1000 men and women, a big number for research indeed Proper functioning of such large establishment required good and efficient organisation There had to be high and accepted standards of law and order in matters like finance, safeguarding of Govt property

and for defence research, preservation of secrecy The men who worked there were men with a difinite mission—War must be won—and they took all the pains to carry out their part for fulfilment of their mission It was their unceasing effort that brought success to T R E or in general to England While at Swanage T R E also developed many new features like the Radar School, the Talkie Film Unit and the most interesting weekly conferences These weekly conferences were attended by the scientists at work as well as the servicemen In the conference every body was allowed the complete freedom of discussions and for this reason these meetings were named as Sunday Soviets In these conferences the the scientists came in closer touch with the men of R A F, Coastal Command and Fighter Command, which greatly accelerated their work This closer contact with the servicemen revealed the user's actual difficulties with radar so that the difficulties could be immediately removed

At a very short notice the T R E had again to be removed from Swanage to Malvern in May, 1942, to take precaution against possible enemy-bombing which actually occurred at Swanage just after a week of T R E's removal At Malvern the establishment was accommodated in the beautiful Malvern College compounds with plenty of open spaces which is so much suited for radar research work As regards the aerodrome facilities they could contact it Defford, about 10 miles from Malvern, the Tele-Communications Flying Unit (T F U) constituted of R A F men Though the place offered all advantages for an applied research establishment, the associate requirements like the Model Shop and Drawing Offices had to be reconstructed

While staying at Malvern no particular new radar device was invented, but the older ones like Oboe, H_2S, A I, etc were made all the more perfect in their uses Moreover, so long the scientists working for radar were engaged in defence devices and had hardly any time to devote for devices to help invasion Some of them, who were sure that sometime radar help would be sought for the invasion of Europe, worked and modified the old devices in that line

The bombing of Hamburg was a landmark in this respect Equipped with micro-wave H_2S, Oboe & Gee, the English bombers in February, 1943, devastated Hamburg creating for themselves a revolution in bombing In this respect it should be mentioned that special cares were taken to minimise the bomber losses over a long period of strategical bombing and to keep the average loss rate at a tolerable figure

Victory of radar devices came from all sections of the war-field, the hostile planes approaching England had been beaten back, and the menace produced by the U-boats was put to an end But the achievement of radar devices could only be felt on the memorable D-Day, the 6th June, 1944, the day of the landing of allied forces on the coasts of France The days following and preceding 6th June experienced worst possible weather But radar provided a separate sense to overcome all of them The ships proceeded accurately in the dark, the coastal batteries of the enemy were accurately bombed and destroyed and the allied planes landed accurately on their desired places In fact the miserable weather that heralded D-Day gave the radar men an opportunity to prove the worth of radar and they really succeeded in that

With more zeal and energy the invasion of Europe went on until the war came to an end

At Malvern T R E maintained their old features like the radar schools, film unit and Sunday Soviets In addition they arranged at Malvern special demonstrations for distinguished guests to domestrate as simply as possible the aims and objects of radar devices At Malvern the number of workers of T R E increased up to 3000 including the cleaners It must not be understood that all of them were scientists In fact only a few hundreds were scientists the rest being the members of the associate branches The only policy that successfully guided this big organisation was to concentrate upon the needs of war without considering the needs of the future of the establishment or of its personnel after the war

At the end of the war it was found useless to maintain such a big establishment for research and the research section was considerably reduced However, the main body of the T R E has still been retained as the Research and Developmental Organisation in Radio and Electronics of the R A F, the Navy, the Army, the Department of Civil Aviation and the Department of Scientific & Industrial Research The total number of employees now working in the establishment is now about 2000 The organisation is composed of four distinct departments

(i) Radar,

(ii) Physics,

(iii) Engineering,

(iv) Electronics—department of the atomic energy establishment

The Radar Department deals with the design and development of navigational and aviational aids The Physics Department is concerned with fundamental researches on properties of extremely short radio waves, infra red radiations and other problems in electronics This department also carries out researches on supersonics and application of radar

techniques in various meteorological problems It also includes a theoretical physics group Engineering Department is responsible for the design and construction of the apparatus according to the requirements of the scientific staff The Electronics Department of the Atomic Energy Research Establishment is responsible for the development of high energy particle accelerators, for nuclear physics, medical research, and for the development of instruments for measuring other radiation, in the field of nuclear physics Quite recently the T R E arranged an Exhibition in which the varieties of interesting equipments developed by the Establishment during and after the war, was demonstrated

The school of electronics of the Ministry of Supplies is also situated within the T R E

The T R E is directly under the Ministry of Supplies and its annual budget amounts to something like 3 millions of pounds

S Chatterjee

UTILIZATION OF THE WILD RELATIVES OF TOMATO FOR BREEDING

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INTRODUCTION

DURING recent decades an increasing amount of attention has been paid by plant breeders and geneticists, particularly in the U S S R , to the wild relatives of cultivated plants The Russian botanists under the leadership of N I Vavilov have introduced many hundreds of new varieties, both wild and cultivated, as a result of extensive explorations in a great part of the Old and New Worlds Similar collections have also been made by the Plant Exploration Service of the United States Department of Agriculture and, on a smaller scale, by other countries These plant collections contain many thousands of new and valuable characters which are being made use of in the improvement by breeding of various cultivated plants The tomato *Lycopersicon esculentum* Mill is among the plants whose wild allies are under investigation in various countries

THE WILD TOMATO SPECIES

Before the publication of two taxonomic monographs on the genus *Lycopersicon*, one by Muller in 1940 and one by Luckwill in 1943, about sixteen species were recognized Muller after a detailed systematic study of the living as well as herbarium material reduced the number to six including a new species added by him Luckwill also was engaged in a similar study about the time Muller's publication appeared He undertook a cytological investigation in addition to studying the external morphology and classified tomatoes into seven species Like Muller, Luckwill also added a new species According to the most recent classification, therefore, the following seven species are recognised

L esculentum Mill
L pimpinellifolium (Jusl) Mill
L pissisi Phil , (Luckwill's new species)
L cheesmani Riley,
L peruvianum (L) Mill ,
L glandulosum C H Muller (Muller's new species),
L hirsutum Humb and Bonpl

With the exception of *L cheesmani* which is truly native outside the American continent, all other species are indigenous to the western coast of South America, having their centre of distribution in Peru The first two species are yellow-fruited or red-fruited annuals having edible fruits The rest are more or less perennial, having non-edible fruits which do not turn yellow or red on ripening The latter group of species is reputed to stand intense drought and high temperature There are indications that amongst the seven species there exists a number of strains and ecotypes having different reactions to various diseases and to varying climatic and soil conditions

USEFUL CHARACTERS OF THE WILD SPECIES

The wild species are considered important chiefly for the high disease resistance exhibited by some of them , *L pimpinellifolium* however possesses some other desirable characters as well The following are the economically-important characters of the wild species .

L pimpinellifolium Large number of fruits per truss (fruits are however very small) ; early

ripening, resistant to Fusarium wilt, Leaf mould, Septoria blight, Colletotrichum fruit rot and Bacterial canker, high vitamin C contents, fruits sub-acid

L. peruvianum Rich in sugar, resistant to tobacco mosaic virus, Leaf mould, Fusarium wilt, Septoria and Alternaria blight and Bacterial spot, also shows nematode resistance, high vitamin C content

L. pissisi Not found to be of any economic importance

L. cheesmani Not found to be of any economic importance

L. hirsutum High degree of resistance to defoliation diseases, Fusarium wilt and tobacco mosaic virus, fruits unpalatable and probably poisonous

L. glandulosum No promising disease-resistant lines have been met with in this species

Utilization of the Wild Species

Crossing of the commercial varieties of the common tomato with selected strains of the wild species has been carried out on a fairly extensive scale in various countries particularly in the United States of America (Florida, Texas, Massachusetts, New Hampshire, South Carolina, Purdue, Missouri, Idaho, Ohio, Nebraska, etc.), Germany, England, Canada, etc., and on a smaller scale in India. From the utilitarian point of view it may be said that the breeding programmes have been planned with the following main objectives in view

1. Obtaining early varieties suitable for off-season growing
2. Obtaining varieties with high vitamin C content
3. Obtaining varieties with high sugar content
4. Obtaining varieties resistant to bacterial, fungal and virus diseases and also to insect pests and nematodes

From the information at present available it is evident that out of the six wild species now recognized only three, viz., *L. pimpinellifolium*, *L. peruvianum*, and *L. hirsutum*, possess desirable characters which could be made use of in tomato breeding. Out of these three it is the red-fruited species, *L. pimpinellifolium*, which has proved the most useful so far and crosses with which have resulted in some improved varieties now grown on a commercial scale

Breeding Work Outside India

Breeding early varieties for out-of-season growing.—In the United States of America work on this aspect was initiated as early as 1937 by Yarnell and Hawthorn. A variety named "Farthest North" has been evolved in the United States of America which combines the extreme earliness of *L. pimpinellifolium* and the large fruit-size and determinate or "self-topping" habit (here growth stops after the plant has developed a certain number of fruit trusses) of the variety Bison of the common tomato. At the New Hampshire Agricultural Experiment Station strains exhibiting extreme earliness have been selected from crosses between Early Chatham (*L. esculentum*) and *L. pimpinellifolium* and *L. peruvianum*.

Breeding for high vitamin content.—*L. peruvianum* has been found to contain the highest vitamin C content, about two to three times that of the commercial tomato varieties. *L. pimpinellifolium* has also high vitamin C content. At Purdue University it has been shown that *L. hirsutum* has several times more pro-vitamin A than the existing commercial varieties. Previously it was believed that it is difficult to combine high vitamin content with large fruit size. But work at New Hampshire where two varieties with high vitamin C content, one small-fruited (Tiny Tim) and one large-fruited (Windrow Box) have been selected has shown the possibility of obtaining such a combination. At the Ohio Experiment Station considerable success has been achieved in uniting the high vitamin C content of *L. peruvianum* var. *humifusum* with varieties of *L. esculentum*.

Breeding for high sugar content.—*L. peruvianum* is rich in reducing sugars and the fruits have a sweetish taste, *L. pimpinellifolium* also has sub-acid fruits. In Germany, about the time when World War II started the German breeders claimed to have developed from crosses with *L. pimpinellifolium*, strains with fairly high sugar content, the fruits of which could be used as dessert like other juicy table fruits. An account of the early work on this aspect was published by Sengbusch and Weissflog (1933). In general it may be stated that several of the economic selections made from crosses with this species are reported to have less acid fruits with a more pleasant flavour than that of the common commercial varieties

Breeding for resistance to bacterial, fungal, and virus diseases and insect pests.—About thirty parasitic diseases of tomato are known to occur in the various tomato-growing countries, caused by fungi, bacteria and viruses. The more serious of these are Fusarium wilt caused by *Fusarium lycopersici* Sacc., leaf mould caused by *Cladosporium fulvum* Cooke, grey leaf spot caused by *Stemphylium solani* Weber, early blight caused by *Alternaria solani* (Ell. & Mart.) Jones and Grout, and spotted wilt and tobacco mosaic viruses. Out of the few pests belonging to the animal kingdom the nematodes are more important. Most of these diseases are important under glass-house con-

ditions and are rare in the open fields Some useful information regarding these diseases is available in Berkeley and Richardson's paper (1944) The plant breeder has been fortunate in having available closely-related wild species, certain strains of which have been experimentally demonstrated to be resistant to the diseases just mentioned Considerable success has been achieved in developing commercial varieties resistant to most of these diseases As a result of hybridisation between Globe and Red Currant (*L pimpinellifolium*) and crossing back the progenies to the cultivated tomato parent, the variety 'Globelle' resistant to leaf mould has been evolved At the Massachusetts Experiment Station another variety resistant to leaf mould and named as Bay State, has been developed from crosses between Waltham Forcing and a selection from the progenies of the cross *L esculentum* × *L pimpinellifolium* Another important variety resulting from the utilization of *L pimpinellifolium* is Pearl Harbour, resistant to spotted wilt virus, produced in Hawaii It is a cross between Bounty (a North Dakota selection) and BC—10 a California production from crosses with *L pimpinellifolium* The Pan-America tomato, highly resistant to Fusarium wilt and somewhat resistant to nematodes, was the result of crosses between Marglobe and a wilt-resistant strain of *L pimpinellifolium* At the Tomato Disease Laboratory, Jacksonville, Texas, two wilt-immune hybrids *viz* T 772 and T 870 have resulted from crosses with the Red Currant species At the Toronto University the variety Vetomold resistant to leaf mould has been similarly developed A very elaborate and complex crossing programme is under way at the Florida (Beckenback 1945) and Hawaii (Frazier et al 1946) Agricultural Experiment Stations for breeding varieties combining resistance to several of the serious diseases and high vitamin C content There appears to be a definite possibility of breeding large-fruited tomatoes of high quality Attempts have been made at Idaho Agricultural Experiment Station to breed varieties resistant to 'curly top' by making use of *L chilense* (now *L peruvianum* var *dentatum*)

A recent article by Macarthur and Chiasson (1947) reviews our knowledge regarding the compatibility and hybrid fertility of various interspecific crosses

WORK DONE IN INDIA

There is no denying the fact that the tomato has received meagre attention at the hands of plant breeders and geneticists in India One reason for this situation may be that unlike in the United States of America and United Kingdom this vegetable crop has not yet secured as much popularity in India It is well known that the tomato is a very nourishing fruit containing perhaps the largest number of vitamins known among vegetables Not only its merits should be pressed systematically to the public but also the methods of utilising it without impairment of its vitamin content of nutritive values Hitherto the only attempts made towards its improvement lay in the haphazard importation and acclimatization of European and American varieties by some of the seed merchants and private individuals In most cases these imported varieties have not even been properly maintained

A few years back tomato breeding work on a small scale was initiated at the Division of Botany, Indian Agricultural Research Institute, New Delhi, to explore the economic possibilities of the utilization of the wild species, particularly *L pimpinellifolium* This species when grown at Delhi was found to be early ripening, developing a large number of small fruits which were non-splitting and with a sub-acid flavour It was however not resistant to virus and cold but withstood hot weather better than the commercial varieties A note on the preliminary results of the cross with *L pimpinellifolium* has been published earlier (Pal and Singh 1943)

In the progenies of the second generation it was observed that quite a large number of the promising plants were rather small-fruited To improve the fruit size, therefore, the hybrid plants of the first and second generation were twice crossed back to the cultivated variety Further "back-crossing", as the process is technically called, was not considered desirable as with the increase in fruit size there occurred a corresponding loss in some other useful qualities such as earliness Up to now eight filial generations and five generations of the second back-cross have been grown and studied Two years ago some of the promising selections were inter-crossed with a view to gain further improvement in earliness while retaining other desirable qualities As a result of selection within the filial as well as the back crosses progenies, some promising lines which are almost pure-breeding are now available, these are in the final stages of selection These cover quite a wide range of fruit-ripening periods, fruit size, flavour, etc Some of these selections are remarkable in that they can be trained to climb on a trellis like a grape-vine and others are 'self-topping' forms which because of the uniform size of the fruits and their uniform maturity are easy to pick, the latter are more suitable for canning purposes Although consumers generally prefer large-sized fruits, requirements in size depend on the use the fruit is to be put to *e g* the small-fruited forms, some of which have unusually attractive colour and shape, are more suitable for eating raw or in the form of tomato juice or soup It has also been observed that unlike the common commercial varieties both the wild species and the

hybrid progenies can give quite large yields of fruits in spite of attack by virus diseases Seeds of a few of the representative selections have been supplied this year to some of the provincial departments of Agriculture for trial under different climatic and soil conditions The selections ripening in the "off season" are particularly important for Delhi and other similar places where rains and frosts limit the cultivation of tomato Side by side, the various selections have been analysed for vitamin C content* and some of them have been found to approach the high vitamin content of the wild parent The vitamin content has however been found to vary from season to season although the general trend of the results has remained the same

Attempt was also made to cross another wild species, *L peruvianum* with the cultivated tomato varieties In this species, under Delhi conditions, flowers are profusely produced and are followed by normal fruits with viable seeds, over a greater part of the year It has been found to be susceptible to virus as well as frost but stands hot weather even better than *L pimpinellifolium* In all the crosses with cultivated varieties of tomato which were attempted it was only when the latter were used as the female parent that some fruits were obtained These were however seedless Further efforts are continuing

A third species, *L hirsutum*, which was grown at Delhi in different seasons formed abundant vegetative growth, flowered profusely but no fruit formation took place at all, the pollen was however normal This species also did not exhibit any resistance to virus or cold No crosses were successful with it in any direction

Suggestions for Further Work

Fortunately the problems of tomato-breeding in India are comparatively simpler than those in other cuntries particularly from the point of view of diseases and insect pests Our major problems are those occasioned by virus diseases and extremes of heat and cold The most effective and economical way of solving these problems would probably be to breed varieties resistant to virus diseases as well as unfavourable seasonal conditions In order to achieve these objectives it would be necessary first to build up a collection of strains or ecotypes of the wild species and standard commercial varieties available in other countries The Indian Agricultural Research Institute proposes to deal with this aspect under the scheme for the Introduction of New Economic Plants which has just been initiated with the aid of a grant from the Indian Council of Agricultural Research

After the material has been obtained it should be studied in different parts of the country keeping in view the regional requirements A suitable breeding programme could then be chalked out

In a country like ours where the bulk of the population is suffering from malnutrition, a nutritious, vitamin-rich crop like tomato which can give yields as high as 40,000 to 50,000 lbs per acre deserves the special attention of plant breeders, geneticists and horticulturists in the country

* The analyses were very kindly made for us by the Division of Chemistry, Indian Agricultural Research Institute, New Delhi

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ELECTRO-CHEMICAL RESEARCH INSTITUTE

THE foundation stone of the Electro-Chemical Research Institute, being the seventh in the chain of National Laboratories, sponsored by the Council of Scientific and Industrial Research was laid on July 25 last at Karaikudi (Madras) by the Hon'ble Pandit Jawaharlal Nehru, Prime Minister and Minister for Scientific Research, Government of India The institute is the first of its kind in India and marks a landmark in the country's industrial development, particularly in the field of chemical research

Laying the foundation stone Pandit Nehru emphasized the determination of the Government of India to apply science to the maximum possible extent to eradicate poverty in the country and to raise the standard of living of the people

Continuing he said that the greatness of a nation was judged not by its armed forces but by a prosperous, contented and productive people "We have to build up an India of this greatness so that she may become a symbol of progress, happy living and productive activity"

He believed that by such undertakings and by the yoking of science to the public good they could advance the lot of the people of India and in this way ultimately solve most of the problems that afflicted them today

He added "I am told people living round about here lack even water to drink They lack the good things of life The first objective of both Provincial and Central Governments must be to provide these and the essentials of life to the people of India

"There are many ways of approaching this problem But the basic and essential way is to strike at the root and to lay the foundations of power and to produce the needs of the people Ultimately, our Government, whether in the provinces or in the Centre, will be judged by this one standard, namely, how far they have advanced the good of the people and bettered their lot "

By the application of science a great deal had been done to humanity, he said "At the same time the application of science has also done a lot of injury to humanity But we shall take the good from science, and I hope this Electro-Chemical Research Institute will produce power which is to be used for raising the life of Indian humanity

"The objective of the scientist must be to raise humanity, to raise human standards, and to help his fellow men. If that is the objective, then every kind of activity is desirable."

The objective of the Government of India, the Prime Minister continued, was to put an end to all poverty and to provide employment to every individual irrespective of his caste, religion or community so that every person might be able to work and produce the necessaries of life and thus contribute to the nation's progress

Addressing the meeting Dr Rm Alagappa Chettiar, an astute industrial magnate, who made the generous gift of 300 acres of land on his estate

Dr Rm Alagappa Chettiar

at Karaikudi and Rs 15 lakhs towards the capital expenditure for the establishment of the Institute, said, "The long and chequered history of India has always given a great lesson to learn While on the one hand kingdoms rose and fell, and wave upon wave of invasions swept over the land and political life degenerated into the byways of courtcraft on the other from the very dawn of the Vedic age the relentless search for truth went on without any relaxing or interruption The mystery of creation, the wonders of the world around, birth and death, the meaning and purpose of life—these created a ferment in the minds of our ancestors Systems upon systems of philosophy were developed New religious faiths came into being A few of them even denied God,

One and all of them flourished, for the burning of the heterodox and the wiping out of the unbeliever were not the ways of India Truth as the mind of man conceived it was sacred and free and it was the search for truth that broadened down from precedent to precedent This is the true history of Indian civilisation, the centuries of mutual endeavour to discover the nature of the synthesis that unifies and explains the seeming contradictions that present themselves on the surface of the Universe The chief feature of Indian culture is this emphasis on freedom of thought In modern times one speaks of the scientific approach In the highest sense of the term it can mean no more than the canalization of disinterested intellectual curiosity and a fearless acceptance of whatever conclusions that flow out By this definition our ancients were scientists in the truest sense of the word We are the inheritors of that scientific approach"

Referring to the selection of Karaikudi as the site for the Institute Dr Chettiar said

"The advantages of Karaikudi for the location of the Institute may not be quite well-known I have been informed by knowledgeable men of science that Karaikudi being situated close to the magnetic equator is suitable as a centre for magnetic studies It is close to the sea and is thus advantageously placed for carrying on oceanographic studies The first grade college I had the privilege to start and which was recently declared open by our Premier of Madras Hon'ble Mr Omandur Reddiar, will be the neighbours to this Institute and hence will have much to learn from and something to give to this great Institute It is my hope to start here an Engineering College immediately, a college which God and the University of Madras willing will start functioning in civil engineering by the academic year 1949 Technological and polytechnic Institutions are next in my list In course of time other branches of learning will, I hope, rise in this area and before long this temple of learning which has been blessed at every stage by good and saintly personages will radiate its halo and enlightenment to all who come within its orbit

"I have in mind the starting of a Research Institute in higher mathematics to be called the Ramanujam Institute of Mathematics—a small remembrance to a great man My scheme for this Ramanujam Institute is ready and I hope it can be started in the not too distant future This together with this great Electro-Chemical Institute which will start its career in a few moments will then form an aggregation of academic units of immense value to the culture and civilisation of our country I am a dreamer, but you will agree dreamers are the most practical of men, for without visions and dreams there is no shaping of the future and I have sufficient faith to feel that more and more of these dreams will soon be transformed into reality"

Requesting Pandit Nehru to lay the foundation stone, Sir Shanti Swarup Bhatnagar, Secretary, Department of Scientific Research, Government of India, said that in 1945, Sri R K Shanmukham Chetty, as Chairman of the Industrial Research Committee of the Council of Scientific and Industrial Research, recognised the need for a specialized research institute for Electro-Chemical Research * The committee was convinced that a national laboratory specially equipped for researches on electro-chemical problems was a *sine-qua-non* for the advancement of electro-chemical industries in India on rational and progressive lines

The Governing Body at its meeting held in February 1948 accepted the generous offer of Dr Rm Alagappa Chettiar and the Hon'ble Prime Minister and the Vice-President, C S I R accepted the suggestion that the Institute should be located at Karaikudi

Referring to the scope and function of the laboratory Sir Shanti Swarup said,

"Electro-chemical processes have completely revolutionized the production of certain primary products such as chlorine, sodium, hydrogen peroxide and aluminium and permitted the development of new secondary industries utilising cheaper raw materials The cost of electrical power is usually the desideratum in these industries While the *per capita* consumption of electric power in India, at the present time, is admittedly low compared to that in U S A, U K and U S S R, it may be expected that before long it will rise several-fold, thanks to the bold policy and drive of the Indian Government in the implementation of vast hydro-electric power projects all over the country Coupled with this the availability of key raw materials and cheap labour will doubtless lead to a vigorous and multi-directional growth of our electro-chemical industries The products of these industries are of considerable strategic and economic importance

"To start with, the Electro-Chemical Research Institute will have two main Divisions, the Electrolytic and the Electro-thermic In addition, there will be ancillary laboratories and workshops consisting of, among others, an Analytical Section, a Chemical Engineering Section, a Testing and Standardization

* The need for electro-chemical researches and their importance have been stressed in this journal much earlier as will appear from the number of notes and articles published from time to time (See SCIENCE & CULTURE, Vol 5, p 350, Vol 9, p 383 and Vol 10, p 79)—Ed *Sci & Cul.*

Section and an Electronics Section The investigations will cover problems relating to

Production of heavy water, other inorganic substances and organic chemicals by electrochemical methods

Electro-deposition,

Passivity and Corrosion,

Electro-metallurgy,

Electrolysis of fused salts,

Primary and Secondary cells,

Electric furnaces,

Electro-analysis,

Electro-thermal processes, and

Electrically activated reactions in gases "

Notes and News

SIR P C RAY MEMORIAL LECTURE

THE First Sir P C Ray Memorial Lecture was delivered by Prof N R Dhar of the Allahabad University on August 2 last, at the University College of Science & Technology, Calcutta The lecture was organized under the auspices of the Indian Chemical Society, of which the late Sir P C Ray was the Founder-President and a benefactor Prof P Ray, President of the Society presided and H E Dr K N Katju, Governor of West Bengal, unveiled a portrait of Sir P C Ray to commemorate the occasion

Speaking on "Nitrogen Transformations in Nature", Prof Dhar said,

"All living substances contain nitrogen as one of its ingredients and hence the supply of nitrogenous matter for plants and animals is perhaps the biggest problem of humanity Neither most plants nor animals can utilize the free nitrogen present in air in building up their bodies There is an essential difference between animals and plants depending upon the fact that plants can thrive on simple inorganic nitrogenous substances like ammonium salts and nitrates for their nitrogen requirements, whilst animals must have complex organic compounds containing not only nitrogen but also carbon, hydrogen, oxygen and frequently sulphur and phosphorus for their existence These substances are known as amino acids and proteins "

Continuing Prof Dhar said, "Researches carried on at Allahabad and elsewhere have definitely established that when ammonium salts are added to the soil as a manure, a large proportion is not utilized by the crop nor it remains in the soil but is wasted as nitrogen gas Moreover it has been proved that inorganic manures do not improve the fertility of the soil permanently as organic manures like cow-dung, farmyard manure, plant residues, leaves, molasses, etc , are capable of doing Rothamsted result obtained from experiments lasting for a century have shown that when even 100 lbs of nitrogen are added per acre in the form of ammonium salt or nitrate it does not improve the nitrogen content of the soil permanently but with farmyard manure at the rate of 14 tons per acre the nitrogen content of the soil is increased 300 per cent This has been explained from the researches carried on at Allahabad University because organic matter leads to nitrogen fixation from air and the protection of soil nitrogen The value of farmyard manure or cowdung depends not only on its nitrogen content as it is generally believed but on its ability to fix atmospheric nitrogen and thus enriching the soil Rain water adds approximately 7 to 8 lbs of nitrogen per acre of land in most parts of India and this is a useful source of nitrogen in a readily available form Alluvial soils of India contain approximately 1000 pounds of total nitrogen per acre of land up to 9 inches deep, whilst the soils in temperate climate contain approximately double the amount of total nitrogen but due to the high temperature and sunlight prevailing in India, the amount of ammonium salts and nitrates which are known as available nitrogen and is actually used by growing plants in building up their body materials is approximately 100 lbs per acre, whilst in colder countries it is 20 lbs A good crop of wheat or paddy requires 30 to 40 lbs of nitrogen per acre This explains why a steady crop yield is observed in most tropical countries even without the addition of any artificial manures The cellulose materials remaining in the soil after harvesting the crops cause nitrogen fixation which is aided by sunlight and this is the chief source of the constant supply of nitrogen in tropical agriculture Researches at Allahabad have shown that more nitrogen is fixed by the help of sunlight on the surface of the earth than the total nitrogen fixed in all industrial concerns of the world,

The source of soil nitrogen is the fixation of nitrogen of the air on soil surface by the oxidation of cellulosic and other organic substances "

Unveiling the portrait of the late Sir P C Ray, H E Dr Katju dwelt on the life and work of the great scientist, who was not only a great scientist but also a great patriot Whenever his nation had called, he had always been ready to help in any way he could He had coupled his profound scientific knowledge with an outstanding devotion to the spinning wheel From the commencement of the non-co-operation movement to the end of his life he had laid great stress on the spinning wheel in order to identify himself with, and showed his sympathy for, India's masses residing in the villages

His was a wonderful personality, closely resembling that of Mahatma Gandhi in a variety of ways He was noted for his austerity and simplicity Unlike the Mahatma, however, who had been forced to live in the limelight, Sir P C Ray lived a life of seclusion surrounded only by his beloved students

STUDIES IN HISTORICAL CHEMISTRY

EVEN at present when many chemical ideas are undergoing changes in the light of the new fundamental knowledge of the nature of matter, more attention is being paid to dig up past history of chemistry Under the editorship of T L Davis, Massachusetts, an editorial committee has been formed for this purpose which includes distinguished scientists of both England and America The editor has recently published a volume of *"Chymia"*, which is an annual study in the history of chemistry It preserves many of the long pursuits, in the course of which alchemy was transmuted into chemistry and includes photographs of some entirely new documents relating to historical discovery, contemporary portraits and illustrations *The Journal of Chemical Education* (June, 1948) contains four articles on historians and history of chemistry in different lands A description of the activities of Dr Ernst Cohen as a historian of Dutch chemistry and that of Dr Charles Albert Browne as an organiser of the Division of History of Chemistry in America have been given with many attractive illustrations That India has her own story to tell in chemistry, had already been proved by the late Sir P C Ray, and has been summarised in the above mentioned issue of that Journal by Professor P Ray, who has lately moved on behalf of the Indian Chemical Society, in the matter of revising the study of ancient Indian chemistry It is hoped that this will bear fruits when the Ministry of Education of the Government of India comes to its aid with necessary financial assistance for which, we understand, the Government and the UNESCO have already been approached by the Indian Chemical Society

SOIL STRUCTURE AND SOIL FERTILITY

THAT fertility plus a favourable soil structure and not fertility alone renders soils capable of producing maximum crops was stressed by Dr A K Dutt, while speaking on "Soil Structure and Soil Fertility" at a meeting of the Botanical Society of Bengal at the University College of Science & Technology, Calcutta Dr K Biswas, Director-designate, Botanical Survey of India, presided

The universal practice to build up and maintain a favourable soil structure is through organic matter and the effectiveness of such a practice depends on the kind and amount of organic matter used It is disappointing to observe that in India soil structure has not yet received as much attention as has soil fertility Field experiments by the speaker have shown that a favourable and stable structure which we need to build up through organic matter can also be built up by using solutions of sodium and potassium silicates with increased yield of crops

Dr Dutt emphasized that our objective should be to develop, not only highly productive soils, but also a permanent agriculture And to develop a permanent agriculture, we need to adopt 'mixed farming', that is, a combination of livestock and crop farming, introducing in the latter a sound and practical rotation in which grass, preferably a mixture of grass and legumes, which is most effective in building up an ideal soil structure, should be grown alternately with row crops and small grains This is the kind of agriculture which can assure us of an adequate and well-balanced diet, and the introduction of such an agriculture in our country is quite practicable

TRACER MICROGRAPHY

A NEW method for the more effective tracing of radioactive isotopes in materials in which they have been intentionally introduced has been developed at the National Bureau of Standards In this procedure, by means of a magnetic focussing arrangement, the radiation given off by a radio-isotope within a sample material is made to form an image of the emitting surface upon a photographic plate The image may then be used in studying the distribution and concentration of the radioactive element present in the sample

In the well-known method of radio autography a radio-isotope is introduced in a biological or other system, and the distribution of that particular element

within the system is determined by bringing the sample in close contact with a photographic emulsion This method lacks resolving power, because, even in case of perfect contact of the sample with the emulsion, the circle of confusion from every point of emission is so great that details less than a tenth of a millimetre are very difficult or impossible to distinguish

In order to improve the resolution of this tracer method, it was decided to use electron optical image formation for determination of the distribution of radioactive element within a given sample This process, which may be called "tracer micrography", is based on the emission of high-speed electrons by many tracer elements and the use of magnetic lens elements for forming an image on a suitable recording surface

In the absence of any means for correction of the chromatic aberration of electron optical lenses, the first micrographs were limited to those elements that emit electrons of uniform speed After some attempts with columbium 93, yttrium 87, strontium 85, strontium 87, protactinium 233, and gallium 67, the latter was selected for the initial tests Gallium chloride, prepared by chemical separation from zinc, was bombarded by heavy hydrogen nuclei in the cyclotron at the Carnegie Institution, and the solution was evaporated drop after drop on a ½-inch tantalum disc Radiation emitted from the surface of the disc, upon passing through a magnetic lens consisting of a small iron-clad coil with Armco iron pole pieces, was brought to a focus on a photographic film at a distance of about 3½ inches An image of the tantalum disc was thus obtained showing radioactive areas The conditions were selected so that a linear magnification of 2 was produced

The simplicity of the method, both in apparatus and technique, is one of its more important features Vacuum requirements are very moderate, since the mean free path of the electrons is large in comparison with the apparatus dimensions, even at forepump pressure

Further improvements in tracer micrography are expected through after-acceleration of the beta particles by means of a homogeneous electrostatic field (*Journal of Chemical Education*, June, 1948)

PROMISING SOURCE OF TITANIUM

DISCOVERY of an extensive, easily accessible deposit of titanium minerals is revealed in the recent report of investigation This is the source of the whitest of paint pigments and from this the U S Bureau of Mines has developed a method of producing a white metal twice as strong as mild steel with very high corrosion resistance The deposit is in the vicinity of Highland, Clay County, Fla Drilling disclosed an area of titanium bearing sand from 3000 to 8000 feet wide and about 19 miles long

The titanium minerals in the deposit include the arizonite variety of ilmenite In addition, the deposit includes other valuable heavy minerals—zircon, monazite, kyanite, sillimanite, and minor amounts of many others

Development of a method of producing ductile titanium, which can be drawn into wire and rolled into thin sheets, has opened up new fields of usefulness which the Bureau is co-operating with industry to explore Titanium pigment has recently been used in the development of a new type porcelain enamel which promised to give a more beautiful finish and greater durability than previously attained The principal properties of the product—chemical inertness, fine texture and high covering power—enabled it to be used for many different purposes including the manufacture of paints, fine paper, cosmetics, nylon and rayon stockings, linoleum, soap, rubber, plastics, and cement (*The Chemical Age*, July 3, 1948)

CHROMATED PROTEIN FILMS

CHROMATED protein coatings offering a convenient, inexpensive means of protecting metals—especially zinc, iron, brass and aluminium—during outdoor storage in mildly corrosive atmospheres have been developed by U S National Bureau of Standards scientists, who say that the protective value of such films is better than that afforded by chemical surface treatments and is much superior to that of corrosion-inhibited oils and waxes In providing protection the metallic surface to be coated is first dipped in casein, albumin, or gelatin , the resultant film is then impregnated with chromate, which both hardens the film and inhibits corrosion

The principal constituents of the chromated protein films are a corrosion inhibitor for the metal, a protein which acts as a vehicle for the inhibitor, a hardening agent, and a bactericide to prevent putrefaction of the protein The four functioning constituents of the film can be applied in a single step or in several steps, according to the compatibility of the agents and the degree of protection desired In the 'two-step' process, which the Bureau found most satisfactory, the metal is first dipped in an aqueous protein solution. When the resulting protein film is dry, it is immersed in an acidified chromate solution for one-half to three minutes and allowed to dry without rinsing The preparation of the protein solution varies somewhat with each protein The

chromate solution contains chromic acid (0 5 to 2 per cent) or a dichromate of zinc, iron or nickel (1 to 10 per cent) Chromated protein films are yellow and, unless opaque pigments have been added, are transparent Their flexibility and adhesion are sufficient to prevent cracking or separation when the metal is bent They are not injured by heating to 150°C (*The Chemical Age,* June 19, 1948)

CAUSE OF CELL VULNERABILITY IN T B FOUND

IDENTIFICATION of a chemical substance in the tubercle bacillus as being responsible for the cell destruction characteristic of tuberculosis has been announced by a Stanford University scientist This bacillary wax-like substance, which is a combination of starches and fatty acids, is the essential ingredient in determining that the body will respond to the protein in the tubercle bacillus with the delayed form of hypersensitivity or allergy which leads to progressive cell destruction in tuberculosis

In the course of experiments with the tubercle bacillus, Sidney Raffel of Stanford Medical School noted that bacterial cells which had been deprived of certain components failed to establish the allergic state By chemical and physical means, including use of high speed centrifuges, he then broke down the bacterial cells and isolated the wax-like fat which he found to be the catalyst which precipitated vulnerability of cells to destruction in tuberculous infection The fat, he reports, does not induce the allergic condition In fact, it causes no reaction But when the proper antigen—in this case the protein—is supplied, the fat is the decisive factor in directing the nature of the body's response

Dr Raffel suggests that the finding may prove to be a fundamental one applicable to all instances in which infection results in this kind of delayed allergy —(*Chemical & Engineering News,* June 28, 1948)

INSULIN FROM WHALES

THE Danish physician William Sterling and H C Hagedorn are investigating the possibility of extracting insulin from the pancreating glands of whales The insulin content of the pancreas of the whale was reported by the investigators as 50 per cent less than that of the pig, but the weight of the gland, 75 kilograms, is a thousand times greater than that of the pig

C J. Labuschagne, of the medical school of Capetown, South Africa, has found that the pancreas of sharks contain a very high percentage of insulin, 1,300 of sharks producing the same amount as obtained from 4,000 to 5,000 cattle "I am convinced", Labuschagne said, "that the production of insulin from sharks would prove a profitable business for any enterprising firm" "What was of particular interest about the whale pancreas", he said, "was its high insulin content , if all the factory ships collected insulin from the whales they cut up, it would increase the world supply and bring down the price " The latest whaling factory ships of Norway, launched in Denmark in April last, would be a modern hospital and laboratory as designed by William Sterling —(*Chemical & Engineering News, 26,* 1948)

VITAL LIVER EXTRACT

SUCCESSFUL isolation of the obscure factor in liver extracts which is responsible for relieving Addisonian pernicious anaemia was claimed by two research teams in England and U S A The potent factor in the liver was a red substance more powerful than any known vitamin or hormone, and was active against pernicious anaemia in the minute dose of 1/200,000 of an ounce It is estimated that no less than 10 tons of liver will be needed to produce a quarter gramme of crystals A dose of one in two millionth of an ounce is likely to be sufficient for the patient, a dose practically unparalleled by any other biological substance known to man —(*The Chemical Age, 58,* 851, 1948)

DEFENCE RESEARCH

DR D S KOTHARI, Professor of Physics and Dean of the Faculty of Science, University of Delhi, has been appointed as the Scientific Adviser to the Ministry of Defence and the Board of scientists advising the Ministry include Dr H J Bhabha, Dr S S Bhatnagar and Dr K S Krishnan

The last war proved beyond doubt the importance of scientific research and development in the conduct of operations On grounds of secrecy and other political reasons, very little was done to encourage scientific research in the Indian Armed Forces and India was dependent almost entirely in this matter on the U K But, even so, it was felt during the war that it was desirable to organise scientific research in defence matters in India to avoid India being entirely dependent on the U K in an emergency In 1946, Dr Wansborough Jones, a distinguished scientist with experience of defence research work in the U K was invited to visit India to advise the Government of India on the subject and he suggested the appointment of an eminent scientist as the head of the Scientific Organisation for the Defence Services of India.

The Defence Ministry after consultation with distinguished Indian scientists, decided to appoint Dr D S Kothari Professor P M S Blackett, a scientist of international repute and an authority on operational research in the U K, has agreed to visit India for short periods every year to advise and assist the Ministry of Defence in the building up of a sound scientific organisation and in pursuing fruitful fields of research in defence science Professor Blackett is just at present on a four-week visit to India He has already visited the Military Academy at Dehradun

ATOMIC ENERGY COMMISSION

THE Government of India have set up an Atomic Energy Commission as per provisions of the 'Atomic Energy Act, 1948' (See *Science and Culture*, *14*, p 66) Dr H J Bhabha, Director, Tata Institute of Fundamental Research will be the Chairman and Dr K S Krishnan, Director, National Physical Laboratory and Dr S S Bhatnagar, Secretary, Ministry of Scientific Research as members of the commission The latter will also act as secretary The commission will carry out its work under the direct guidance of Pandit Nehru, the Prime Minister and Minister for Scientific Research

The commission would enforce the provisions of the Atomic Energy Act by taking such steps as may be necessary to protect the interests of the country in connection with atomic energy, survey the territories of the Indian Dominion for the location of useful minerals connected with atomic energy and promote research in their own laboratories and subsidize research in existing institutions and universities and provide teaching and research facilities in nuclear physics in Indian universities

ANNOUNCEMENTS

PROF MANECK B PITHAWALLA of the University of Sind (Pakistan) has been elected Foreign Corresponding Secretary of the American Society for Professional Geographers

SRI P K Basu Mallick, Lecturer in History, Hindu College, Delhi, is appointed Registrar, College of Engineering and Technology, Jadavpur, (West Bengal) Son of the late Raja Subodh Chandra Basu Mallick (founder-benefactor of the National Council of Education, Bengal), Sri Basu Mallick is a political sufferer and was involved in the Inter-provincial conspiracy case, 1933 Later in 1937 he obtained honours degree in History from the Trinity College, Cambridge, and was Professor of History at the Presidency College, Calcutta, from 1938-40

A HALF-YEARLY list of Zoological papers published in India, Burma, Pakistan and Ceylon will be issued along with the *Proceedings of the Zoological Society of Bengal* in March and September every year The Zoological Society of Bengal, 35 Ballygunge Circular Road, Calcutta, seeks the co-operation of all zoologists in India, Burma, Pakistan and Ceylon and requests them to send copies of their reprints of papers published in 1948 to facilitate the proposed compilation for the current year and all subsequent years

THE Scientific Co-ordination Committee of the Department of Scientific Research as announced earlier (See *Science and Culture, 14*, p 66) will consist of Dr S S Bhatnagar, Dr J C Ghosh, Prof P C Mahalanobis, Dr J N Mukherji, Dr C G Pandit, and Maj -Gen S S Sokhey

PROF S Bhagavatam, Head of the Department of Physics, Andhra University, Waltair is appointed as Indian Scientific Liaison Officer in the U K Dr Bhagavantam will shortly take up his new appointment

SIR Ben Lockspeiser,, chief scientist to the British Ministry of Supply and Sir Alfred Egerton, secretary of the Royal Society have arrived in India, to review the work of the Indian Institute of Science, Bangalore, as desired by the Government of India Dr Egerton is the chairman of this committee, and the third member is Dr J N Mukherji, Director, Indian Agricultural Research Institute, New Delhi

THE following awards of Research Fellowships have been made by the Council of the National Institute of Sciences of India for the year 1948-49

A *National Institute of Sciences Senior Research Fellowships*

Dr J Bhimasenachar (Physics), Andhra University, Waltair
Dr S D Chatterjee (Physics), Bose Institute, Calcutta
Dr B D Tilak (Chemistry), Bombay University, Bombay
Dr L S Ramaswami (Zoology), Mysore University, Bangalore

B *National Institute of Science Junior Research Fellowships*

Mr U Burman (Mathematics), Calcutta University
Mr B K Banerjea (Physics), Calcutta University
Mr K Das Gupta (Physics), Calcutta University
Mr P C Mukherjee (Chemistry), Calcutta University
Mr S Veda Raman (Chemistry), Indian Institute of Science, Bangalore
Mr Y Sunder Rao (Botany), Government College, Hoshiarpur, East Punjab
Mr S D Misra (Zoology), Lucknow University

C *Imperial Chemical Industries (India) Research Fellowships.*

Dr R G Chatterjee (Chemistry), Calcutta University
Mr K Venkateswarlu (Physics), Andhra University, Waltair
Mr T V Deshikachary (Botany), Madras University
Mr J Mitra (Botany), Calcutta University
Mr T V R Pillay (Zoology), Zoological Survey of India
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BOOK REVIEWS

Dynamic Aspects of Biochemistry—By Ernest Baldwin Cambridge University Press, 1947 Pp 457 Price 21s net

During recent years a body of fundamental knowledge has been built up in the science of Biochemistry, which relates to the chemical events that underlie all living phenomena In the early stages, naturally, a mass of facts had to be accumulated regarding the chemical substances which are present in tissues and also regarding the end products of reactions occurring in the body Without this knowledge it is obviously impossible to follow the reactions which occur in the living cell through various stages The understanding of the biochemical events is in a sense even more fascinating than the study of single chemical substance isolated from biological materials In the book under review, Dr Baldwin has dealt with the subject from this dynamic standpoint Biochemistry has now become an independent discipline in most progressive Universities and in the teaching of the subject this dynamic aspect should be brought before the student as early as possible, so that he may soon get into the habit of thinking in terms of the dynamics of the reactions that produce the phenomena associated with life The book is expected to serve this purpose

Part I of the book deals with enzymes There are chapters on the general properties of enzymes, the nature of the enzymatic reactions, the hydrolases, phosphorylases, oxidising enzymes and other enzymes In these chapters the physico-chemical aspects of the enzymatic process are fully dealt with and up-to-date information is presented Particularly interesting are the sections on the "adding", "transferring" and "isomerizing" enzymes The newer researches on trans-amination, trans-amidination, trans-methylation etc are described There is also at the end of this part a classification of the enzymes

Metabolism is dealt with in detail in part II of the book In one chapter the general methods used in the study of intermediary metabolism are described In other chapters the metabolism of food, with particular reference to the metabolism of proteins, amino-acids, purines, carbo-hydrates and fats, are described Most of the latest work on these subjects has been brought together in these chapters and critically surveyed The biochemistry of alcoholic fermentation and of the amaerobic metabolism of carbohydrates in muscle and liver on which so much interesting information has been gathered in recent years has been particularly fully dealt with

The merit of the book is that it is true to its title, that is to say it gives a perspective of Biochemistry from the dynamic standpoint Those observations and interpretations which relate to the reactions of the living cell are critically as well as synthetically presented, so that one gets a certain 'philosophical' satisfaction The author does not miss the wood of the trees Another special merit of the book is that it is very lucidly written and both the elementary and advanced students of Biochemistry would derive considerable benefit from its perusal It has got a fairly large bibliography and there are indexes of authors and subjects

B C G

German Primer for Science Students—By Hara Gopal Biswas, M Sc , D Phil Published by the University of Calcutta, Second edition 1948 Royal Octavo Pp xiii+250 Price Rs 7/8/- only

I feel no hesitation in congratulating the author of this very useful publication For one, who had never been to Germany, to write a Primer like this on the language of that country, reflects no mean credit to his ability The book may, therefore, be named a "German Self-taught" in the true sense of the word Having succeeded in learning German so well with his own unaided efforts, the author is best qualified to show the way of his success to others And this has, I believe, been fully proved by the publication of the Second Edition of the book

After dealing with the essential matters of Grammar the author has devoted one section to literature and one on each of the important branches of science These sections contain also illustrative passages with their English translation, which are so cleverly chosen that, because of their interesting and instructive contents, they assume greater importance than mere exercises of lessons in grammar and translation This removes in a great measure the boredom or dullness which the beginners usually experience in going through lessons or exercises for learning a foreign language The volume ends in a vocabulary of nouns, verbs, and qualifying words used in science, arranged in separate groups

The book can be whole-heartedly recommended to all students of science who desire to have a working knowledge of German

P. R

Municipal Labour in Calcutta—By K P Chattopadhyay and G Ray Published by the Department of Anthropology, Calcutta University, 1947 Pp 36 Price Re 1/1

This pamphlet does credit to the authors and also discloses a sorry state of affairs pertaining to the staff of the Corporation of Calcutta Of about 1800 workers a sample survey of 402 families was made by Sri Gautamsankar Ray It is true that very recently the lot of about 1500 persons who at the time of the survey were receiving a "pay" of Rs 16/- per month has been "ameliorated", but still the general picture outlined in the pamphlet is valid The short pamphlet is factual and helpful in its own way, but a more ambitious and human document comparable to Charles Booth's survey of London Life and Labour (sometime ago brought "up-to-date" in several volumes by scholars under the aegis of the London School of Economics) is yet to come Still, the family budget analyses, (still more unbalanced in recent months by the continuing 'racket' in prices of essential commodities), the figures regarding expenditure on intoxicants, the housing conditions tell their own tale to the great shame of Calcutta of human exploitation and misery

B N B

Modern Physics—By G E M Jauncey, D Sc (third edition, 1948) Published by D Van Nostrand Company, Inc , New York Price $6 00 or 33*s*

According to author this is a second course in College Physics , it corresponds to B Sc Honours School of Physics of Indian Universities Our course will be dangerously incomplete if the most progressive science of physics is taught in colleges ignoring the modern developments in the course Such topics as radio, electronics and atomic energy will be of absorbing interest to the students learning in colleges While a good grounding in "Some useful mathematics" and classical physics is a prerequisite for a clear comprehension of "modern physics", Prof Jauncey has not omitted to incorporate such topics in the earlier parts of the book For without the essentials of classical physics one cannot visualise in true perspective the modern aspects of the subject The book can be analysed into three principal sections In the first section we find such topics as Wave motion, Alternating Currents, Electromagnetic Theory of Radiation, Moving Charged Bodies and the Electron, Kinetic Theory of Gases, Specific Heats and Heat Radiation In the 2nd section can be included the following topics Electrons in Metals, The Photoelectric effect, Electronics and Radio, Special Theory of Relativity, X rays and some applications thereof In the third section we like to incorporate his following chapters Bohr Theory of Spectra, The Quantum Theory, Critical Potentials, Radioactivity and Isotopes, Nuclear Physics (with Nuclear Fission), Cosmic Rays, Astrophysics, and General Theory of Relativity The chapter on "Philosophical Implications" appended at the end to give a bright finishing touch is mainly based on Heisenberg's Uncertainty Principle (as enunciated in 1927) Towards the end of each chapter some exercises are given, which, we believe, will enable the student to master the theme to his satisfaction, and help him in a great measure in answering University questions in quite a neat and accurate way We can safely recommend this volume to the care of the teacher and the student taking degree Honours

K M B

Science and the Nation—Published by Penguin Books, Harmondsworth, Middlesex, England, 1947, p 249 Price one shilling

THIS is a book sponsored by the Association of Scientific Workers of Great Britain and include nineteen chapters of an unusually wide range of interrelated subjects being the 'spare-time work of a group of mostly young men and women, scientists, engineers and social scientists', who believe that 'the artificial and stultifying separation of the social and natural sciences should cease' The book is intended for the enlightenment of every citizen and 'is concerned with the future of British Science and with the application of its new strength to the solution of the problems of peace' The book may as well be studied with profit in India and elsewhere In a short introduction Prof P M S Blackett, President of the association and the well known British Scientist has hinted the necessity of a Central Body to survey the numerous uncoordinated government departments and private industries Educationists will be particularly interested in the later chapters on science as part of culture, science in general education, the training of scientists, and the politics of science

A K G

LETTERS TO THE EDITOR

[*The Editors are not responsible for the views expressed in the letters*]

RECLAIMING THE INDIAN DESERT

I

WITH reference to Pithawalla's article[1] I have to point out that the Luni River basin lies completely outside Jaipur territory, to the west, and in no way contributes to the wealth of that State

There are in existence six large bunds on the Luni River and its tributaries and of these only one fills with anything like reasonable frequency namely in five years out of thirteen, the Pichiak Reservoir on the Luni River itself, located about 40 miles east of Jodhpur, has only overflowed once since 1930 and therefore it will be obvious that it would not be economically feasible to increase the number of reservoirs on this River system

The statement that the river tends to increase its width cannot be substantiated, the width varies according to the geology and topography of the country through which it passes and in the middle reach of the river, some sixteen miles west of Balotra, the river is confined to a narrow gorge in a conglomerate overlying a rhyolite basement, below this gorge, for a distance of some 40 miles, the bed is still comparatively narrow as the river is hemmed in by sand dume formations

There are some localities in the higher reaches where the bed widens considerably due to the presence of rock bars which reduce the gradient causing the velocity to decrease to an extent which results in the dropping of the sand being transported

Jodhpur Government is in the process of constructing a dam on the upper reaches of the Jawai River, which is the only important tributary remaining without a storage reservoir, but even in this case it is only economically feasible to consider storing some 7,500 mill cu ft whereas the maximum computed flow, based on 76 years rainfall records, would be some 20,000 mill cu ft

The reference to the revival of the Luni Valley and the thousands of acres of land which would be catered for is, in the writer's opinion, unbridled optimism which does considerable harm

The rainfall of the bulk of the Luni River Valley does not exceed 14 inches per annum and, in view of the sandy nature of the country the eventual run-off to the river cannot but be small, providing no opportunity for storage works

It is not possible to store in years of heavy rainfall and carry through to years of deficit rainfall because the annual evaporation loss alone is in excess of seven feet and in any case reservoir sites of sufficient capacity do not exist nor would they be economically feasible if they did exist

There is no doubt that conditions in the semi-desert areas of western Rajputana could be considerably improved by attention to afforestation, control of grazing, improvement of small local storage tanks and contour *bunding* but funds will be needed on a far more generous scale than has been the case in the past

F F FERGUSSON

Public Works Department,
Government of Jodhpur,
Jodhpur (Rajputana),
17-3-1948

[1] Pithawalla, M B, SCIENCE AND CULTURE, *13*, 367, 1948

II

Mr Fergusson's comments on the hydrography of the Luni basin, are welcome It is gratifying to find that my article on the partial reclamation of Indian Desert, has stimulated the interest of State engineers like Mr Fergusson

The errors pointed out by him are not so serious and my reply to these are stated below

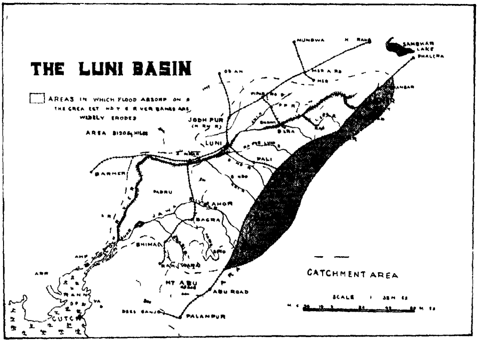
1 *Jodhpur and the Luni basin* —There is an unfortunate typographical error, on p 370 (*loc cit* column 2, line 34) It is admitted that while the Jaipur State is in no way benefitted by the Luni waters, "half the agricultural produce of the Jodhpur State is the gift of the Luni", as there is a saying in Marwar [1] I still contend that something must be and can be done for a hydrographical control of the numerous rivers, small and big, contributing their share to the Luni water supply Not less than 9 of them have been marked by me in the map in the whole basin, covering some 9120 sq miles

2 *Damming and Bunding* —Most of Mr Fergusson's remarks pertain to the engineer-

ing operation of *damming* the river and its tributaries and the *storage* of rain water in the desert area But I myself have not recommended such a method, knowing full well that both absorption and evaporation are in the extreme in this part of the desert To make this point clear, I quote the relevant passage from my article "To prevent all the good waters draining the eastern margin of the desert from being wasted into the Rann of Cutch, engineers should construct some terraces and *bunds* across the Luni and its tributaries in the upper reaches, in order that the discharge may be controlled and the waters allowed to flow smoothly and slowly downstream Contour terracing for waters spread over a larger area in the Luni basin than would otherwise be the case

Mr Fergusson himself admits that there are six *dams* (or are they only weirs, specifications not being given?) already constructed on the different tributaries and they are naturally not so successful, and yet he has stated that a new (seventh) dam is being tried on the most important tributary, the Jawai, of the Luni river This should have been done earlier, as according to his calculation, at least 7,500 million cubic feet of water have been wasted every year from this source, cost or no cost!

3 *Increasing width of the river channel* —This is not only a fact but the important plea of



raising more wheat crops is recommended For preventing inroads of sand, green vegetation screens and other solid but permeable barriers have to be constructed along the banks of the rivers" What I have already stressed upon, therefore, is a *method of preventing the floods* (and they are rather frequent in this tract) by constructing low *bunds* and contour terraces to control the waters, allow them to run smoothly and slowly downstream and to give time to the cultivators to enable them to utilise *as much of the running water as possible*, instead of allowing the streams to run away as the flashy nature of the Luni always permits These flood mine *to make some good use of this happy circumstance* agriculturally Mr Fergusson admits that in the higher reaches at least the bed widens and he gives the physiographic reason of the rock bars preventing the sudden flow It is exactly this lesson from nature that we must learn in order to modify at least the flashy nature of the Luni and controlling the floods for a while, and not allow lakhs of cusecs of precious water (as many as 260,000 in 1944 flood, according to Sir Claude Inglis[2]) to run to waste suddenly into the sands and the sea

But the river definitely widens in other areas as well for another reason *viz*, its

tendency not to scour its bed but erode *its banks instead,* with every flood Some dry crops must be raised on the flooded areas on both sides of the river valleys (*e g* , dotted areas marked on the accompanying map) This is *nature's method of irrigating the desert parts* of the Luni, and must be taken advantage of by us by means of modern engineering devices We know that for about 15-20 miles between Bhawi and Luni Junction, the stream is narrow, being controlled by the geology and the Malani rhyolites and other igneous rocks preventing erosion From Guha where a caravan route crosses the bed of the river to Ranodar another junction of camel paths, the river divides itself into several channels, then being overcome by sand dunes, it reduces itself to a singular narrow stream before falling into the swamp and salt beds Besides, there are many natural islands formed in the bed of the river due to deposition of the sand and silt charge, in many places and these can also be irrigated and cultivated From Chawan to Tilwara and beyond, there are other pretty broad channels, parallel to the Jodhpur railway lines, which are frequently damaged by the incoming floods The left bank of the Luni, especially the Doab between the Jawai and the Luni, is more hopeful in this respect than other parts, which are on the windward side and damaged by the rain of sands from the Rann Tube wells should be tried here In this connection I should like to quote the example of the Gomal river in the Trans-Indus zone in the Punjab Here the rain waters are all used up in irrigating the Dera Ismail Khan district *before* the river has any chance to meet the Indus in the lower ground

4 *The sand nuisance* —It is admitted that this character of the Luni river, of ever widening its bed, is overpowered by Nature again by the accumulation of drift sand But Mr Furgusson agrees with me that this nuisance can be stopped by planting suitable vegetation in a scheme of afforestation to be prepared by the State

5 *Rainfall and run-off* —Mr Fergusson is not quite right when he gives the average rainfall of the basin to be 14 inches only It is on an average 18 95 inches Besides, this particular Luni basin is fortunate in having both the Storm Tracts in India (the S W monsoon and the western depressions) passing across it for the greater part of the year, an exceptionally favourable circumstance in a "desert" area like this, inasmuch as the rainfall is spread over a longer period here than in other parts in the south One would like to know what happens to this decent rainfall every year, when in drift arid Baluchistan and N W F Province, much less rainfall (hardly 3-5"), is utilised by means of Karezes and hillside terraces Moreover, Heron has suggested an increase of rainfall in Rajputana in recent years[1]

At the same time, it should be admitted that there is little relation here between rainfall and run-off, so that it is *not* in years of heavier rainfall *e g* , 1907 and 1925, that there is greater run-off and any damage is then done by the floods, but it is on the contrary in years of *lower* rainfall, as in 1908, 1917, 1926 and 1944, that such is the case The whole flood cycle lasts for about a fortnight only in August September It is for this reason that some up-to-date engineering works should be constructed to prevent such an excessive run-off at unexpected times

The whole object of my article, therefore, has been to present a *synthetic* view of the Luni basin and to make a *regional* survey of the entire area for the civil and irrigation engineers to see that they can certainly help to "Grow more food" even in the "desert" and advance the cause of Free India Luckily Mr Fergusson himself has endorsed in his last paragraph my views and my own recommendations of afforestation, control of grazing, contour *bunding* etc So there is at least *some hope of revival of the Indian Desert* on this steppe-desert side, even according to the Jodhpur State engineer

The question of finance, forced into the issue by Mr Fergusson, should not arise here in this good work that we can do for India's national planning, now that all the Native States in India are being reorganised by the Government of the Indian Union and steps are being taken for preventing any wastage of their revenues in State luxurious ways and top-heavy expenditures

MANECK B PITHAWALLA

N E D Government Engineering College,
Karachi, 15-5-1948

[1] Singh, R P , "The Topography of Rajputana", *Ind Geog Jour* 22 p 40

[2] Annual Report of the Central Irrigation and Hydro-dynamic Research Station, Poona, 1945, pp 47-48

NATURE OF CONCENTRATED SHELLAC SOLUTIONS

The depolarisation of the transversely scattered light by shellac solutions has been explained on the assumption of the existence of molecular clusters in solution[1], the clusters have further been assumed to grow bigger and stabler at higher concentrations The cluster formation of course results from the influence of secondary valency forces In dilute solutions the shellac molecules are so far apart that the van der Waal's force cannot operate The greater the concentration of shellac, less is the distance between the dissolved molecules and consequently greater is the association or cluster formation

It may, therefore, be assumed, that more and more energy will be required to displace a molecule from its neighbour[2] as the concentration of shellac is increased and thus the activation energy for viscous flow will increase with concentration

The calculation of activation energy for viscous flow at various concentrations was done from the temperature coefficient of specific viscosity ($\eta_{sp} = \eta/\eta_0 - 1$) of the shellac solutions The results for ethyl alcoholic solution are given in Table I

TABLE I

% of shellac	E (cal/mole)
5	1247
15	1645
20	1894
30	2967
40	4158
50	5455

The value of E increases rapidly at higher concentrations in case of other solvents and mixed solvents also

The measurements of anomalous viscosity also showed that above 30% concentration of shellac, yield value also increased rapidly while at lower concentrations yield value was extremely small The results for ethyl alcoholic solution are given in Table II

TABLE II

% of shellac	Yield value (dynes/cm ²)
20	9
30	20
40	33
50	50
60	150

In no case, however, it was possible to detect rigidity in static experiment using Swedoff's[3] elastometer This is most probably due to the fact that the molecules in the cluster have got pronounced equilibrium distance, *i e*, they are so far apart and possess so much energy, both kinetic and potential that they are not very far from instability

Thanks are due to Dr P K Bose, Director, Indian Lac Research Institute, Namkum, Ranchi, for his keen interest in the present work

SADHAN BASU

Indian Lac Research Institute,
Namkum, Ranchi,
16-5 1948

[1] Basu, SCIENCE AND CULTURE, *14* 79 1948
[2] Andrad, *Phil Mag* *17* 497 698, 1934
[3] Hatschek, The Viscosity of Liquids, 1928, p 224

OCCURRENCE OF *ISOSPORA DIRUMPENS* HOARE IN THE INTESTINE OF THE GRASS SNAKE *NATRIX PLATYCEPS* AT MUKTESWAR*

The examination of ten specimens of the grass snake, *Natrix platyceps*, captured at Mukteswar (height above the sea level, 7,500 ft), during the months of July to September, 1947, revealed a coccidial infection in two individuals Oocysts found in the faeces were indentical with those of *Isospora dirumpens* Hoare[1] described from the "Puff Adder" (*Bitis arietans*) collected near Entebbe (S Africa) Thus a new host, *Natrix platyceps* for *I dirumpens* is recorded from India, a country situated so wide apart from the 'original' home of this coccidium

In the first instance numerous spores with four sporozoites in each were seen, which were provisionally identified as *Cryptosporidia* sp ,[2] but this was soon dismissed because on closer examination several thin-walled unruptured oocysts of *I dirumpens* were also encountered in the same sample of faeces Such oocysts contained mature spores

Sporogony of this coccidium was completed within the host tissues and that is why usually only free sporocysts were recovered from the faeces Parasites occurred mostly in the subepithelial tissues of the small intestine as described by Hoare

In all respects the oocysts and sporocysts of this coccidium from the grass snake conformed to the description of *I dirumpens* Hoare In the majority of sporocysts from the grass snake, however, the residual body presented a scattered appearance rather than a compact mass of protoplasm as described by Hoare in the coccidium from the "Puff Adder"

* Read before the Section of Zoology and Entomology, 35th Session of the Indian Science Congress held at Patna in January, 1948

We are deeply indebted to Dr E R Becker of Iowa State College of Science, U S A, for kindly providing us with a photostat of Triffitt's article

H N RAY
HARBANS SINGH

Indian Veterinary Research Institute,
Mukteswar-Kumaon, U P,
7 6-1948

[1] Hoare, C A, *Parasitology*, 25 359, 1933
[2] Triffitt, M J, Observations on two new species of coccidia parasitic in snakes *Protozoology* No 1, 19, 1925

POLYESTERIFICATION OF HYDROXY ACIDS PART I 12 HYDROXY STEARIC ACID

THE study of the polyesterification reaction has been mainly confined to the condensation of polyhydric alcohols with polybasic acids[1] although it was recognised that the same condition is also present in the hydroxy acid molecules In the present series of investigations the author has carried out a systematic study of the self esterification of hydroxy acids in which both the number and the position of hydroxyl group in the molecule were varied The present part summarises the report of work on self-esterification of 12-hydroxy stearic acid

A known quantity of hydroxy acid was heated in a current of dry air at varying temperatures maintained within 1°C The samples were drawn at definite intervals, quickly chilled in a freezing mixture and the acid and sap values determined from which the extent of reaction could be calculated It was noticed that with the reaction continuing under isothermal conditions, the amount of free acidity decreased, percentage esterification increasing proportionately while the saponification values practically remained constant The data obtained at three different temperatures, namely, 200°, 220° and 240°C are given in Table I

TABLE I

t (hrs)	200°C		220°C		240°C	
	A V	E V %	A V	E V %	A V	E V %
½	151 3	18	136 1	28	111 1	39
¾	—	—	121 9	34	92 4	49
1	132 1	28	110 5	40	85 8	53
1¼	—	—	102 5	44	75 7	59
1½	120 1	34	—	—	67 6	63
1¾	—	—	99 0	46	64 6	65
2	110 2	40	91 9	50	59 1	68
2½	101 3	45				
3	96 4	47				
3½	90 2	51				

The results clearly demonstrate that the reaction is continuous and does not occur stepwise as would have been the case if it yielded a dimer first, then a tetramer and so on

Moreover, if the acid value-water evolved curves are compared with the theoretical curves drawn on the assumption of interesterification, it is found that the water evolved is slightly less than the theoretical values If on the other hand, ether, lactone or anhydride formation occurred simultaneously with esterification, the observed values of water evolved would have been higher than the quantities calculated on the basis of esterification

Further light may be thrown on the nature of the reaction by applying Arrhenius[2] equation

$$\log_e K_1/K_2 = \frac{Q}{R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$$

For this, reaction at each temperature was carried out to the same stage, i e, 50 per cent whence it follows that $K_1 \propto 1/t_1$ and $K_2 \propto 1/t_2$ where t_1 and t_2 are the periods of time in which the reaction reaches the 50 per cent stage at the respective temperature T_1 and T_2 Substituting this value of t_2/t_1 for K_1/K_2 in the equation the value of Q, the activation energy, comes out to be 24 71 K-cal This compares fairly well with the activation energy for esterification[3]

A more detailed study of the reaction from the Kinetic standpoint led to results of additional interest The overall reaction was found to be a third order one This may be explained on the assumption that since all esterification reactions are catalysed by acids, in absence of such a catalyst one molecule of the carboxylic acid itself functions as a catalyst, making the reaction velocity proportional to the cube of acid concentration When the reaction was catalysed by 0 5 per cent β-naphthol sulphonic acid, the reaction was found to be a bimolecular one with respect to carboxyl concentration

My thanks are due to Dr P K Bose, Director, Indian Lac Research Institute, Namkum, Ranchi, for his keen interest in the present work

SADHAN BASU

Indian Lac Research Institute,
Namkum, Ranchi
17-6-1948

[1] Collected papers of Carothers High Polymers, Vol I, Mark and Whitby, Inter Science Publishers, 1 Ne, New York
[2] Glodschmidt, *Z physikal chem*, 60, 723, 1907
[3] Hinshelwood, *J Chem Soc*, 1593, 1939

STUDIES ON THE CHEMOTHERAPY OF *VIBRIO CHOLERAE*

SULPHA drugs are being largely used in the treatment of various infections, but their chemotherapy against *Vibrio Cholerae* has so far not been extensively studied Sadusk and Oswald[1] undertook to determine the effect of sulpha-thiazole, sulphadiazine, sulphaguanidine and sulphanilamide upon *V Cholerae* in media free of inhibitors Subsequently Sen and Basu[2] noticed a definite bacteriostatic action of sulphanilyl benzamide Recently Bhatnagar *et al*[3] has reported that a compound "6257" isolated by reacting sulphathiazole with formalin is effective in human cholera infection The nature of this sulphathiazole derivative (*cf* Basu[4]) suggests that for exerting proper chemotherapeutic activity against an infection the sulpha compound must be ingested in a way that it may be present at the site of the infection in its active anion form with free amino grouping for blocking the acid group of the enzyme protein (*cf*, Klotz, Davis and Wood[5]) The observation of Poth and Ross[7] on the activity of insoluble phthalyl sulphathiazole in bacillary dysentery infection also leads to the same conclusion

In view of these findings it was considered to be of interest to study the bacteriostatic as well as bactericidal activity of the compounds that might again be obtained by substituting the N^4-hydrogen atom of sulphanilyl benzamide[8] against *V Cholerae* This sulpha compound readily reacts with formalin or hexamine in dilute alcoholic solution to afford 4 hydroxymethylamino benzene sulphon benzamide (I) in crops of microscopic crystals m p 160°, soluble in dilute alkalies but insoluble in dilute acid The anti-bacterial activity of this compound is being studied against *V Cholerae* in comparison with the sulphathiazole derivative '6257', and similar compound (II) m p 222° derived from sulphacetamide The corresponding derivatives from sulphadiazine and sulphamerazine obtained by condensing with formaldehyde are readily soluble in dilute acids Details of the whole work would be published elsewhere The Table here shows the activity of compounds recorded in column (I) against smooth strains of *V Cholerae* (Inaba and Ogawa) from a 18 hours young culture on alkaline agar The inhibition of growth was noticed in one per cent peptone (Difco-Bacto) water at *p*H ca 8 with an inoculum of 1 million cells per 5 c c of the medium for a period of 24 hours at 35-37°C The minimal bactericidal concentration was ascertained by using 2 c c of each of the above 24 hours incubated dilution as inoculum for 15 c c of alkaline agar at 45°C well mixed and poured into plates These were subsequently incubated at 35-37°C for a period of 96 hours The figures in the Table indicate the concentrations that maintain the sterility of the plates over that period

TABLE

Invitro ACTIVITY AGAINST *V Cholerae*

Figures indicate milligrams of the Compound per c c

Compound (I)	Bactericidal		Bacteriostatic	
	Inaba	Ogawa	Inaba	Ogawa
"6257"	5 0	5 0	0 4	0 9
Sulphanilyl benzamide derivative (I)	3 5	3 75	0 7	0 85
Sulphacetamide derivative (II)	5 0	5 25	0 8	1 0

From the Table it may be noticed that the compound (I) exerts an enhanced bactericidal activity This characteristic along with its ready solubility in alkaline *p*H points to the necessity of a thorough study of its *in vivo* activity against *V Cholerae*

N K S RAO
U P BASU

Bengal Immunity Research Institute
Calcutta, 16-7-1948

1 Sadusk and Oswald *Amer J Trop Med* *23* 275 1943
2 Sen and Basu *Ind Med Gaz* *80* 194, 1945
3 Bhatnagar *et al* *Nature* *161* 395, 1948
4 Basu, U P, SCIENCE AND CULTURE, *14*, 36, 1948
5 Klotz, J M, *Science*, *98*, 60, 1943
6 Davis and Wood, *Proc Soc Expt Biol Med*, *51* 283 1942
7 Poth and Ross, *J Lab Clin Med* *29*, 185, 1944
8 Sikdar and Basu, *J Ind Chem Soc* *22* 343, 1946

COCCIDEAN PESTS ON THE FRUIT TREES OF DARJEELING DISTRICT

A SURVEY of the incidence of insect pests in fruits in the Darjeeling District, carried out by the author in 1946, reveals the frequent occurrence of a group of of pests of the Family Coccidae These evade the notices of the grower because of their minute and inconspicuous size and as in some cases they resemble in colour the puparium with the bark of the host plant

These insects suck up the juice of the food plant by their piercing and suctorial proboscis resulting in extreme cases in the ultimate death of twigs The tiny young larvae soon after hatching move about very slowly for about 30—50 hrs and then anchor themselves somewhere on the host plant, preferably the succulent portion The males, if winged, emerge out with two wings, these apparently appear lifeless and so are always overlooked as harmless dots

Prof Comstock said 'there is no group of insect which is of greater interest to the horticulturists today than the Coccidae' The presence of the notorious scale—*Quadraspidiotus perniciosus*, Comst, in Bengal on Plum (*Prunus communis*, L) and on Peach (*Prunus persica*, Benth et Hook) fully justifies the above remark Besides *Q perniciosus*, Comst , there are other coccidean pests causing menace to other fruit crops such as Orange (*Citrus aurantium*, L), Apple (*Pyrus malus*, L), Guava (*Psidium guayava*, L), Mulberry (*Morus* sp), etc These are taking heavy toll of fruits every year

Name of the Coccid pest	Locality	Name of the host plant	Region of attack	Intensity of infestation	Total No of plants examined	Total No of infested plants	Percentage of infestation
Quadraspidiotus perniciosus Comst	Kalimpong (3,200 ft - (3,800 ft)	*Prunus communis*, L & *P persica*, Benth et Hook	Trunk & twig	Mild Medium	80 14	15 2	18 7% 14 2%
Hemiberlesia rapax Comst	„	*Pyrus communis* L & *Psidium guayava*, L	Twig Twigs & leaves	Mild Mild Medium	30 10	2 3	6 6% 30 %
Hemiberlesia lataniae, Sign	„	*Pyrus malus*, L	Twig	Mild	4	1	25 %
Lepidosaphes gloverii, Packard	„	*Citrus aurantium*, L (Washington naval)	Apical regions of twigs and fruits	Severe	80	25	31 2%
Lecanium hemisphaericum, Targ	„	„	„	„	80	12	15 %
Lecanium punctulife rum, Gr	„	„	„	Mild	80	8	10 %
Pseudococcus longispinus, Westwood	„	„	„	Medium	80	12	15 %
Aonidiella aurantii Maskell	„	*Citrus aurantifolia* Swingle (Sweet lime)	Twigs & leaves	Medium Severe	Found on a dying tree		
Lepidosaphes beckii, New	„	„	„	„	„	„	
Pulvinaria psidii Mask	„	*Psidium guayava*, L	Twig	Medium	10	2	20 %
Pseudaulacaspis pentagona, Targ	„	*Morus* sp	Twig	Severe	10	4	40 %

Rahaman and Ansari[1] have reported *Q perniciosus*, Comst from Punjab, Kashmir Valley, United Provinces, N W F Province and South Waziristan Agency This species attacks a good number of deciduous fruit tree while *Aonidiella aurantii*, Mask , from Punjab and N W F Province causes harm to a number of plants but mainly of Citrus Family

Ayyar has reported from South India the *Lepidosaphes gloverii*, Packard, on Guava[2] (*Psidium* sp), *L beckii*, New , on citrus fruits, *Lecanium hemisphaericum*, Targ , on citrus plants, tea etc , and *Pseudococcus longispinus*, Targ , on cocoanut leaves

The present note deals with a list of Coccidean pests with the percentage of infestation on their host plant in Bengal, so as to find out the primary food plant as determined by these incidences and so that the relative preference to the host plant is shown by the pests The result is given in the table above

It would appear from the table that *Q perniciosus*, Comst , prefers Plum (*Prunus communis*, L) to Peach (*P persica*, Benth et Hook) and the former may be regarded as the primary food plant in Bengal Similarly, Guava (*Psidium* sp) may be regarded as the primary host for *Hemiberlesia rapax*, Comst Again, *Citrus aurantium*, L (Washington naval) appear to be very susceptible to the attack of *Lepidosaphes gloverii*, Pack , *Lecanium hemisphaericum*, Targ , *L punctuliferum*, Gr , and *Pseudococcus longispinus*, Westwood, while the local varieties show definite resistance to these pests as evident from 120 plants examined and found free from them

Thanks are due to Dr V P Rao, Bangalore, for kindly confirming the identity of the pests

N Dutt

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Agriculture Department, W Bengal
Chinsura, 19-7-1948

[1] Rahaman, Khan A and Ansari A R *Ind Journ Agric Sc* , *11*, 816-830, 1941

[2] Ayyar, T V R , *Bull Agric Res Inst* Pusa, 197, 1929

IN SEARCH OF ANTIBIOTICS

I

Bose[1] has recently pleaded for a systematic investigation on Indian fungi for the exploration of antibiotics The development of such therapeutically useful substances as tyrothricin and penicillin has led to the present concept of antibiotics which, of course, may now be defined as a chemical compound derived

from or produced by living organisms and capable of inhibiting the life processes of micro-organisms in small concentration

In search for antibiotics surveys of enormous numbers of organisms, fungi, actinomycetes, bacteria, lichens and even higher plants, have been made Bose[1] has himself mentioned that several hundreds of fungi have been tested in various countries to produce antibacterial substances But seldom they show any promise whatever of being of use in medicine In the words of Florey[2] it may be said that the examination of the fungi has so far been in general disappointing This does not mean that Indian flora should not be explored, but a co-ordinated team work amongst mycologists, biochemists, chemists, bacteriologists and pharmacologists would be more necessary before any antibiotic can be made available for clinical trials Without showing any inferiority complex we may direct our attention towards a study also on the aerobic spore-forming organisms and on various lichens as much interest is now being displayed in them as a possible source of antibiotic against acid-fast organisms

Marshak's[3] interesting investigations on the lichen *Ramalina reticulata* and studies on diploicin isolated from the lichen *Buella canescens* by Barry[4] point to a systematic investigation on lichen acids for possible isolation of an antibiotic against gram-negative bacteria This may ultimately remove the scourges of typhoid, tuberculosis or even diphtheria

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Bengal Immunity Research Institute,
Calcutta, 19-7-1948

[1] Bose, S R, SCIENCE AND CULTURE, *14* 38, 1948
[2] Florey, H, *J Amer Med Assoc* *135* 1047, 1947
[3] Marshak, A *et al Science* *106* 394, 1947
[4] Barry, V C, *Nature*, *158*, 131, 863, 1946

II

Regarding the remarks of Dr U P Basu in the above note that fungi show seldom any promise whatever of being of use in medicine and that examination of fungi, according to Florey, has so far in general been disappointing, I think the following remarks of W J Robbins *et al*,[1] who have worked on a number of higher fungi from antibiotic standpoint, may be quoted with appropriateness —"It seems clear that many of the Basidiomycetes produce substances which, at considerable dilution, inhibit the growth of some kinds of bacteria We have no evidence so far for the production of any substance as active as penicillin On the other hand, we have investigated only about 300 of the 30,000 species in this group, and one of the 29,700 which remain (to be investigated), may produce a substance with the activity of penicillin "

S R BOSE

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Calcutta, 19-8-1948

[1] Robbins, W J, Kavanagh, F, and Harvey, A, Conference on Antibiotics, Part I *Microbiological Ann New York Acad Sc* *48* 72, 1946

SODA CELLULOSE FROM JUTE FIBRE

SIRKAR and SAHA[1] first observed that the structure of the hydrated cellulose obtained from raw jute fibre is different from that of hydrated cellulose from ramie This difference was attributed to the presence of higher percentage of lignin in jute fibre These observations have been confirmed recently by Sen and Woods[2], who have found that the spacings of the (101) planes in hydrated cellulose from jute fibre containing different quantities of lignin vary from 7 4 A° to 8 3 A°

It was, however, not known whether the structure of soda cellulose prepared from raw jute fibre is the same as that obtained from ramie This question has therefore been investigated and the results obtained are given in table I The soda cellulose from raw jute fibre was obtained by treating raw jute fibre with NaOH solutions of concentration up to 45 per cent and washing the product with absolute alcohol to make it free from adhering caustic soda

TALBE I

Equatorial reflections	hkl	Spacings in A° (Present author)	Spacings in A° (Hess and Trogus)[3]
A_1	101	8 2	12 66
A_2	101	4 52	4 6
A_3	002	4 15	4 3

It can be seen from table I that the spacings of (101) and (002) planes are nearly the same in two cases, but the spacings of (101) plane in case of soda cellulose from jute fibre is much less than that in soda cellulose from ramie

The spacings given in the last column of table I are those obtained by calculating from the patterns

due to soda cellulose I reproduced by Hess and Trogus[3] They further observed that when NaOH solutions of strength higher than 21 per cent are used in the treatment of ramie fibre, soda cellulose II, having a structure entirely different from that of soda cellulose I, is produced In the case of raw jute fibre, however, it has been observed in the present investigation that solutions of NaOH of strength varying from 15 per cent up to 45 per cent reacting on raw jute fibre produce soda cellulose of the same structure and soda cellulose II is never produced in these reactions The detailed results obtained in the present investigation will be published elsewhere very shortly

Thanks are due to Prof M N Saha, and Prof S C Sirkar for encouragement and keen interest in the work Thanks are also due to Indian Central Jute Committee for financial help

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Calcutta, 5 8-1948

[1] Sirkar and Saha, *Nature, 157,* 839 1946, *Proc Nat Inst Sc India, 13* 1 1947
[2] Sen and Woods, *Nature, 161* 768, 1948
[3] Hess and Trogus, *Z Physik Chem* (B), *11* 381, 1930

SOFT X RAY K EMISSION AND ABSORPTION SPECTRA OF SODIUM HALIDES AND THEIR ULTRA VIOLET ABSORPTION BANDS

K VALENCE BAND emission spectra of Na in NaF, NaCl, NaBr, NaI, corresponding to the transition of 3 S,P electrons surrounding halogen ion, to the vacant K level of the Na atom have been taken with a bent Gypsum crystal in a vacuum spectrograph The band widths gradually increase from Fluoride to Iodide The bands having three structures or more have been attributed to the structure of valence electrons associated with the halogen ion of the particular halide The peak having the longest wavelength is attributed to the transition of 3s electrons surrounding the halogen ion of the particular halide into the vacant K level of the Na atom The two peaks on the short wavelength side are due to $3p_1$ and $3p_2$ structures in 3p band of the particular halide The energy difference between $3p_1$ and $3p_2$ structures of Cl spectra in NaCl agree well with the energy difference in the structure of Na spectra in NaCl[1]

K-absorption edges of Na in Na-halides have been taken by Kenneth C Rule[2] of Upsala from which the K emission structures of the corresponding halides are subtracted, all expressed in electron volts The difference is found to be in agreement with the values of the ultra-violet absorption edges of the corresponding halides taken by Hilsch and Pohl[3]

In the case of NaCl, the same values of ultra-violet absorption edges have been obtained by subtracting K valence band structure of Cl in NaCl from the K absorption edge of the particular chloride, all in e v The 3S band of NaCl is reflected in the metal ion spectra, and is not to be found in the Cl spectra of NaCl, which in the latter case is forbidden by the selection principle The agreement obtained in the case of NaCl by working in Na and in Cl region permit us to give a schematic representation of the valence electron energy diagram in NaCl Such agreement has also been found in the case of KCl Detail is soon going to be published in the *Indian Journal of Physics*

SOFT X RAY K EMISSION AND ABSORPTION SPECTRA AND ULTRA VIOLET ABSORPTION BANDS

Specimen	K Valence Band Spectra of Na in NaX		Na K Absorption Edge in NaX K	K-Edge E_1 e v	Ultra-Violet Absorption Bands	K-Edge E_2 e v	Ultra-Violet Absorption Bands
	E_1 in e v	E_2 in e v					
NaF	1062 9	1064 7	1073 3	10 4	10 6	8 6	
NaCl	1063 3	1065 4	1073 3	10 0	9 6	7 9	7 8
NaBr	1063 1	1065 1	1073 1	10 0	9 8	8 0	8 5
NaI	1062 5	1064 8	1073 1	10 6	10 1	8 3	8 7

Thanks are due to Prof S N Bose for his kind interest in the work and for the facilities given to me in his laboratory

K DAS GUPTA

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Calcutta, 24-7-1948

[1] K Das Gupta, *Ind Jour Phys, 21,* 1947
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SCIENCE AND CULTURE

A Monthly Journal of Natural and Cultural Sciences

Vol. 14 OCTOBER 1948 No 4

PROBLEM OF RADIO INDUSTRY IN INDIA

WITHIN the past few decades, radio has grown into a subject of tremendous national importance due to its wide applications in such vital services as public entertainments, communication, propaganda and above all defence In consequence the radio-electric industry now plays an important role in the economy of all the advanced countries of the world The great potentialities of radio in defence services was recognised during the first World War and it is no wonder that after the war, England, the U S A and other industrialised countries endeavoured hard for the retention of technical supremacy in radio-electric industry As a result, industrial concerns like the Marconi's in England, the R C A in the U S A and the Phillips' in Holland grew up to gigantic dimensions from modest beginnings Extensive and intensive programme of research on radio was also undertaken by the leading Universities of these countries and new results of fundamental and technological importance were obtained out of these efforts The results were utilized during the second World War for the development of Radar and other devices for defence The story of the prominent role that the Radar played not only in the defence of England against the determined German air attacks but also in carrying the aerial warfare within the heart of the German mainland with decisive consequence, is now well known (See SCIENCE AND CULTURE, *11*, 343, 1946) It has been said that the invention of radar is as important an event in warfare as the invention of gun-powder and the internal combustion engine

Supply of radio electrical goods manufactured indigenously have therefore become essential for the existence of all the independent and modern nations of the world It is needless to point out the grave danger associated with the absolute dependence on foreign supplies for such a vital instrument of peace and war, yet, the unpleasant fact remains that India has so far no radio industry in the strictest sense of the term There might be attempts on the part of a few firms to assemble imported components and to make radio sets of their own There might even be cases of a few enterprising persons trying to manufacture a few components here and there But these cases can at best be called amateurish attempts in the sense that there has been no standardisation of these products and that their method of production is not quick and economic enough to withstand the onslaught of competition with finer foreign goods Independent India can ill-afford to allow this deplorable state of affairs to continue The question of establishment of a well organised and full fledged radio-electric industry is now in the fore-front and we are glad to understand that plans are being matured in this direction by the Ministry of Industries and Supply of the Government of India We take the opportunity of discussing some aspects of radio industry and make a few suggestions regarding its establishment in India

FINANCIAL POSITION

Interested quarters often contend that radio industry in India cannot be a financially sound proposition at this stage A survey of the present requirements of radio-electrical goods in this country, however, would easily convince one of the futility of such contention The future industry will have to supply the requirements of both the State services and also of the public consumers Under State services, are included the three arms of Defence, the All India Radio, Posts and Telegraphs, Meteorology, Railways, Government Overseas Communication Services and Provincial and Central Police Unfortunately, we are not in possession of the exact figures of requirements of these various Departments But in consideration of the fact that almost all of these departments will, sooner or later, be expanded on a

scale commensurate with the new political status of the country, we can safely assume that the total requirements for the State services will exceed several crores of rupees per annum The extent of requirements of public consumers can roughly be estimated from the fact that during the period from 1st of April 1946 to 31st of January 1947 the total worth of radio electrical goods imported was more than 1 5 crores of rupees There has been steep rise in the number of receiving sets purchased from abroad During the last 10 years the number of licenses for receiving sets have increased by about 200 per cent and it is expected that this trend towards increase will continue indefinitely as the economic level of the country goes up The needs of the country are thus expected to be about 5 to 6 crores at the present moment, which will go up in geometric progression till it reaches the dimensions it has in the U S A Unless we take steps to make radio goods in our own country we shall have to spend several crores of rupees per annum for purchasing foreign goods—undoubtedly a heavy toll on India's balance of trade and a great handicap to the growth and maintenance of some essential State services in cases of emergency On the other hand, with the possibility of a sale of a few crores worth of goods every year a start can be given to a radio-electrical industry without any fear of decay, due to lack of market for its products

How to Start Factories

There are, however, several difficulties in the way of establishing the radio-electric industry and the matter demands serious consideration and cautious handling The chief among these is firstly the difficulty of obtaining some essential raw materials, for example, stalloy sheets for transformers and chokes, permanent magnets for loudspeakers and telephones, etc , kraft paper for condensers, pure aluminium foil for electrolytic condensers, not to speak of such common goods as copper and aluminium wires of all grades Any plan for a future radio industry in this country will have to take into account this important factor and plans should also be afoot simultaneously for starting the production of these raw materials For some of these materials, facilities for manufacture already exist in some allied factories of the country But for those materials for which there does not exist any facility, we would suggest that the Government of India should take steps to establish factories of their own as a part of the bigger project of radio-electric industry

The second great difficulty confronting the proposed industry is the lack of technical personnel There may be isolated cases of a few Indians who have specialised in some selected techniques of manufacture of radio electrical goods , but it will be impossible to find a team of Indian technicians capable of setting up and running a manufacturing establishment It is no use dreaming that we can get our men trained from abroad We cannot expect that a foreign firm will undertake to train Indians with the prospect of liquidation of their own market in India The alternative of appointing foreign experts with fat salaries also offers, in this case as in others, no practical solution, because, as experience has shown, such foreign experts for reason of continuance of their own services, and for safeguarding the interests of their own countries, do not prove very helpful in training Indian technicians The only practical solution of this baffling problem is for the Government of India to seek help of foreign firms of established reputation on the basis of certain specific business terms, which we do not want to suggest at this stage specifically We wish to invite the attention of the Government of India to the parallel case of Soviet Russia In the post-revolution days, Russia was in the same position as we are today in regard to radio-electric industry She had no radio-electric industry worth the name, but had urgent need for the same for security of her new-born State Under these circumstances, the Government of U S S R approached the R C A. for co-operation in starting a full-fledged radio factory in their country An agreement was reached under which the R C A had to supply the machineries, train Russian technicians and supply design and technical data for the manufacturing processes, in return of a suitable royalty The factory was not to be just an assembly plant but was to include manufacturing plants for all the essential components including the valves It is interesting to note that the R C A do not manufacture components like the variable condensers and the resistors But for implementing their contract with the U S S R they made arrangements with other firms to supply the necessary machinery and to train Russian technicians in the manufacture of these components The procedure enabled Russia to develop her radio industry smoothly and quickly so that they proved quite a match for their German adversaries in this matter when World War II came Of other countries, we understand that Argentina also adopted a policy similar to that of Russia to start her own radio industry The Government of India would be well advised to adopt a similar line of action in this matter

The aim of this contract will naturally be to make India self-sufficient in respect of radio-electric goods of all descriptions In realising this aim it may be necessary to establish more than one factory each devoted to the manufacture of a particular set of equipment and components , for instance, there may be a factory for the manufacture of valves, another for the manufacture of resistors and condensers, still

another for the manufacture of transmitters, and so on It may also be found necessary to permit privately owned factories for the manufacture of some of the less important items While this question and the details of the organisational structure will have to be worked out in the light of the practical conveniences and the advice tendered by the foreign firms, with whom the Government associates certain broad principles, on which the plan should be based can be suggested at this place

A Brain Centre for Factories

A little study of the history of development of radio-electric industry would show that throughout its years of infancy and adolescence the industry has been continually and profoundly influenced by the results of research To realise this one has only to remember that almost every significant development in radio like the thermionic valve, radar and microwave generator, have sprung from the results of fundamental investigations carried out in University Laboratories Speedy utilisation of the facts emerging out of fundamental investigations had been effected by well-organised Design and Development research carried out in industrial firms It may also be noted that in spite of its rapid growth during the past 50 years, radio is, even now, a growing subject and new facts and techniques are being constantly evolved making the older methods partly or wholly obsolete In view of these facts every big radio industrial organisation of the world includes, apart from the usual production factory, fully equipped laboratories for design and developmental research The truth of this assertion can be understood from the fact that research laboratories of the Bell Telephones (U S A) alone employs as many as 99 chemists, 147 physicists, 22 metallurgists, 2137 engineers, 525 technical assistants, 620 draftsmen, 949 laboratory and developmental mechanics and 3301 additional personnel Yet, these lobaratories are regarded secondary in importance to the University Laboratories of the country as source of fundamental discoveries The soil which does not provide a continuous supply of such discoveries and the means of quick harnessing of the same should be regarded as barren so far as radio-electric industry is concerned and no amount of artificial means can protect the industry from the inevitable decay In planning the industry, therefore, steps should be taken to provide means for the subsistence, growth and constant revitalization of the industry by results of fundamental research

Let us see how this can be effectively done and start with fundamental research For encouragement of fundamental research it is suggested that the Government should take steps to sponsor extensive programmes of research in the Universities and other National Laboratories We propose to discuss this important question in detail in some future issue

Design and Developmental researches for this, *it is suggested* that the Government should as *an essential part of its scheme for radio-industry establish a Central Design and Development Organisation which would serve as the brain centre and parent body of all production factories* This organisation will be a sort of connecting link between the different pro

RADIO IN FRANCE

Research	Development	Production
Centre National d'Etude des Telecommunication (National Centre of Telecommunication Education) 24 Rue Bertrand, Paris Laboratoire de Radioelectricite (Radioelectricity Laboratory) Bureau National d'Etude de Recherche Aeronautique (Radio Division) (National Bureau of Aeronautical Research Radio Division) Under C S F In the Universities	Compagnie Francaise de Telegraphie sans fil (French Wireless Telegraphy Company) (C S F) 79, Boulevard Hausmann, Paris 1200 workers Capital—10^8 francs	(1) La Societe Francaise Radio-Electrique—S F R (French Radio Electric Society) (2) La Societe Independante de T S F—S I F (Independent Society of Wireless) (3) La Steatite Industrielle—S I (The Industrial Steatite Co) (4) La Societe des Traitements Electrolytiques and Electrothermiques et le Revetment Electrotechnique—S T E I (Society for electrolytic and electrothermic treatments and electrotechnical reconditioning) (5) La Compagnie Radio Cinema—C R C (Radio Cinema Company) (6) La Compagnie Industrielle des Metaux Electronique (Industrial Company of Electronic metals) La Society des Alliages Bures—S A O (Society of Hard Alloys) (7) La Societe Auxiliere pour la fabrication des produits electroniques—S A P P E (Auxiliary Society for manufacture of electronic products) (8) La Compagnie Radio France—R F (The Radio France Company) (9) La Compagnie Radio Maritime—C R M (Marine Radio Co) (10) La Compagnie Radio Orient—R O (Oriental Radio Co)

duction factories, whether State-owned or State-sponsored, and will represent the Government at the Directorate of all these factories Such an organisation not only ensures co-ordination of work but also a substantial saving in financial and technical enterprise The central organisation itself should be managed by a Board consisting of representatives of the various State-services like the Defence, All India Radio, Civil Aviation, etc and a fair proportion of University men who have made substantial contributions to the science of radio, and of industries which have direct bearing on radio Such model has been in operation in France and has been found to work well In France, Compagnie Francaise de Telephie Sans Fil (C S F) controls almost the entire radio industry of the country The C S F by itself is a central design and development establishment which carries out work up to the manufacture of prototypes The production business is carried out by a chain of its subsidiary factories which number about 10 The C S F financially participates in the activities of these factories The chart in the previous page shows the organisation of the radio-electric industry in France

The closest possible co-operation should be maintained between the University laboratories and the radio industry To this end the Central Radio Establishment might include a Liaison Branch, whose duty will be to maintain collaboration with the Universities, the Department of Scientific Research and the Ministry of Education Unless industry goes hand in hand with science like this, cross fertilising each other in turns, it is bound to collapse under advancing tide of new developments from other countries

It is hoped that attention of the Government authorities would be drawn to these suggestions while formulating the detailed plan for radio industry in India

ELECTRONICS IN INDUSTRY

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OF the various contributions of Physics to modern industry those pertaining to Electronics rank amongst the highests Broadly speaking, electronics is the science of the control of the emission of electrons and of electronic currents Electric power devices are not generally included within the domain of Electronics though they may carry or control electric currents Such devices are concerned with immensely large numbers of electrons moving at very low velocities, not exceeding a few centimetres per second Electronic devices on the other hand deal with smaller numbers of electrons moving at very high speeds, thousands of kilometres per second, giving currents of the same order Electronics may therefore be regarded as that branch of physics which deals with the emission and the control of high speed electrons passing through vacuum or gas

Electronics was for a long time confined in the field of communication and entertainment During recent years, however, its use has extended far beyond these limits One of the reasons why the application of electronic devices in Industry has been comparatively slow is that the mechanical engineer has not been aware of the available and potential electronic devices which could solve many of his problems Further, electron tubes of the required types were not properly developed, nor were available in quantity It is the impact of war that has been responsible for the rapid development and perfection of many non-radio electronic devices The result has been so encouraging as to usher in the age of industrial electronics In spite of its extensive applications to industrial problems the word Electronics is quite often misunderstood by the average engineer to whom electronics signifies the radio and allied fields alone The object of the present article is to give the reader an idea of the growing applications of electronic devices to industry

Applications to Industry—Classified

The industrial applications that have so far been successful may be broadly classified under eight heads Regulation, Control, Heating, Power Conversion, Safety devices, Production testing uses, Molecular vibration uses and Measurements and Analyses The classification is by no means rigid but it fairly well represents the variety of present applications Brief accounts of some of the typical applications under each head are given below

Control and Regulation

The Control and Regulation equipments consist of three essential stages. (i) a detecting device that

converts the change in the physical quantity to be controlled into an electrical impulse, (ii) a suitable vacuum tube amplifier to increase the strength of this impulse and (iii) the device which actually performs the controlling or regulating operation in the desired manner under the influence of these amplified pulses The change in the physical quantity may be one of electric voltage, current or resistance, change in temperature, pressure, colour, change in speed, humidity, turbidity, rate of flow, thickness of coating and a large variety of such other effects The detecting device depends upon the nature of the physical change to be controlled The actuating device may conveniently be either an electrical or electro-mechanical system which operates either purely electrically or by means of an electromagnet or electric motor Automatic door-openers, burglar alarms, etc , are some of the simplest well known applications A few other illustrations may be of interest

Electronic devices are now used to regulate the output voltage of dynamos which are subjected to wide speed variations A typical arrangement, shown in Fig 1, is to supply the field current of the dynamo

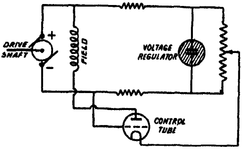

FIG 1 Voltage control for dynamo With increase of dynamo voltage, grid of control tube becomes more negative, this reduces the field current and hence tends to stabilise the dynamo voltage

through a vacuum tube in such a way that when the speed of the dynamo increases, the negative bias on the grid of the tube increases This reduces the field current and tends to maintain the output voltage constant

Control of motor speed under varying load is an urgent necessity in many industries Accurate turning of metal parts on the lathe where the depth of cut and hence the load on motor varies demands constancy of the speed of turning In the textile industry, variations of loom driving speed results in bad quality of cloth In paper industry again, accurate control of machine speed is essential for uniformity of the finished product. Even a small variation in speed due to fluctuation in load or supply voltage may seriously affect the quality of the paper For large installations D C motors are generally used in such cases because they are easier to control Electronic motor speed control equipments have now been developed which can maintain the speed of even the largest motors at any specified value The Westinghouse Mot-O-trol and the General Electric Thymotrol are typical of such devices The Mot-O-trol is designed to operate on the field of an exciter which in turn supplies the control field of a generator in a generator-motor combination Fig 2 shows a

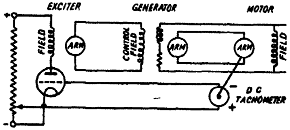

FIG 2 Speed control for D C motor Increase in motor speed develops higher voltage in tachometer This reduces exciter field and generator voltage and hence motor field, thus tending to maintain constant speed

schematic arrangement of the complete system A d c tachometer, driven by the main motor develops a voltage depending on the speed This is utilized to control the grid of valve supplying the exciter field In actual practice phase-shifting devices are incorporated to prevent hunting of the motor Further the exciter field is actually energized by a three-phase half-wave rectifier utilizing three thyratrons whose grids are controlled by the tachometer voltage The General Electric Thymotrol has also been developed for the same purpose and is a more flexible and elaborate equipment

Temperature regulation is important in many industrial operations In resistance heater type furnaces rough control can of course be obtained by non-electric devices such as bi-metallic strips but very close regulation within a few thousandths of a degree is attainable only by electronic devices The detecting device is usually a resistance thermometer used as one arm of an A C bridge which is balanced at the specified operating temperature In case of temperature shift the bridge is out of balance and the unbalance voltage, after suitable amplification, is applied to grids of thyratrons The plate current of the thyratrons is utilized to saturate the core of a saturable reactor through which the A C heating current of the furnace flows Very close regulation is easily obtained in this way

In addition to current strength the timing or duration of flow is also easily controlled by electronic means. In resistance-welding metals like aluminium and magnesium which have a sharp fusion point, in-

accuracy of timing of welding may melt either too much or too little of the metal resulting in bad quality Electronic equipments with synchronous ignition timing system have been developed to facilitate such work For fabricating assemblies made of aluminium electronic devices are now used which pass accurately controlled welding current many times a second When the assembly is moved past the welder, the result is equivalent to "sewing" Control of time interval is a very important feature in many industrial processes and for short intervals electronic devices are ideal Electronic equipments involving time-dealy circuits have also been developed to control processes where a number of operations are to be carried out in a desired sequence A novel method of electronic control has been used in an American hydro-electric substation In an electric power generating station where the demand varies throughout the day it is certainly desirable to generate the power in accordance with the demand A graph has been drawn to represent the variation of average demand throughout the twentyfour hours A photocell follows this preset graph and controls machinery which releases the requisite amount of water power for generating the desired electricity

It is well known that the moisture content in the warp determines the strength and quality of the threads and hence the quality of textile fabrics Moisture content depends upon such factors as air temperature and humidity of operation room, speed of the warps over the drying cylinders, etc Each of these factors can of course be controlled individually by non-electronic means but since they are interdependent their co-ordination is essential, though very difficult Recently electronic controls have been developed with good results

Various other electronic equipments have been devised for control and regulation work These have the general advantage of speed and sensitivity of operation Further electronic devices are most convenient for remote control These function without moving parts and friction and wear being thus eliminated, they operate unattended and have longer life

Heating

One of the most important applications of electronics in industry is for generating high frequency power for heating The importance of electronic heating will be realised from the fact that today electronic power used for heating is many times that used for broadcasting and communication The demand of electronic generators has been so great that commercial equipments of a large variety of sizes from a few kilowatts to 250 kilowatts are nowadays available There are two distinct methods of high frequency heating—Induction and Dielectric heating

Induction heating is suitable for metallic and conducting materials A wide range of frequencies is used depending upon the material to be heated and also upon the nature of the job For deep heat penetration, resulting in melting, frequencies between 1 and 10 kc/s are generally used, these frequencies are often generated by rotary generators For surface heating of metals, case hardening and similar work, frequencies between 100 and 500 kc/s are useful, whereas for surface heating of metal strips, wires, etc, higher frequencies up to one or more megacycles per second are used Induction heating was successfully applied to the tin-plating industry during the War when the supply of tin became meagre With ordinary plating if the tin coating be made very thin, the deposit is uneven and results in high porosity of the coated surface The latest technique is to pass the electroplated sheet, as shown in Fig 3, through

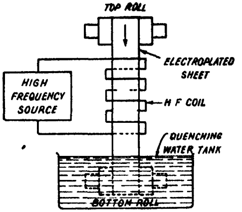

FIG 3 Finishing tin-plated sheets by H F heating The electroplated sheet is made to pass through a coil carrying h f current The coating thereby melts and is uniformly spread over the surface

a coil of rectangular form wound as close to the sheet as possible In a typical installation 30 inch sheets have thus been finished at the rate of 1200 feet per minute, the frequency used being 200 kc/s

Dielectric heating suitable for non-metals is used for drying wood, yarns, ropes, foods and many other substances Plastics and rubber are cured, plastics preheated for moulding and wood and plastics bonded together by this method Electronic preheating saves time in all the three steps of the moulding cycle—press closing, curing and removing the final products Rejects are also greatly reduced In a typical test for thick moulds the curing time was only 5 minutes with electronic preheating whereas with the old moulding method it required more than two hours of curing This is because electronic preheating

keeps the moulding material at a uniformly high temperature when moulding begins and hence only a short time is needed for the mould heat to produce an excellent cure Plywood manufacturers have normally to keep the boards under pressure for days till the glue is dried up Dielectric heating, as depicted in Fig 4, has now reduced the time to minutes

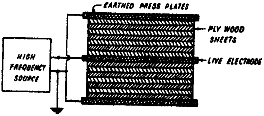

FIG 4 High-frequency heating in plywood manufacture The glue is dried up in a few minutes

Dielectric heating is also widely used for sterilisation, cooking of food, agricultural products, tobacco, etc , and for pasteurising milk Many pharmaceutical products like penicillin and antitoxins lose their desirable properties if the material is in liquid solution for a long time These solutions, are, however, generally susceptible to heat and are therefore dried under high vacuum by sublimation Much quicker drying has recently been effected by dielectric heating even under moderate vacuum

Dielectric heating has also proved advantageous in the glass industry Its special advantage is that the entire volume of the substance is uniformly heated Surface boiling is therefore avoided and hence loss of volatile constituents Since these factors limit the heating speed and the size and thickness of the parts to be heated, the advantage of electronic heating is obvious Moreover the heating time can be accurately controlled and the application of heat localised Thus electronic heating reduces processing time and the maintenance costs and also requires less floor space The frequency used for glass generally lies between 20 and 30 Mc/s

Power Conversion

Conversion of A C power into D C has been greatly facilitated by electronic devices The ignitron rectifier is a very efficient device and can deliver power continuously though unattended, because it has no major moving parts These are now extensively used in modern aluminium and magnesium production plants The special advantage of the ignitron over the ordinary mercury arc rectifier is that the arc in the ignitron is started electrically It is therefore not necessary to maintain the vapour within the tube continuously ionised as in the mercury arc type It was due to the development of such rectifiers that the U S A could produce the aluminium needed for the manufacture of huge quantities of aeroplanes during the War The ignitron is also largely used as shown in Fig 5, for controlling the

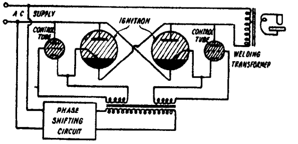

FIG 5 Ignitron welding control The two ignitron tubes are connected back to-back and are triggered off by thyratrons associated with each

flow of the powerful currents, sometimes about 10,000 or even a few 100,000 amperes, used in resistance welding Noisy mechanical contactors or switches which were previously used for this purpose, are not only bulky but have short life The ignitron has solved all these difficulties

A special application of electronics in the Electric Power industry is in D C transmission This consists in transforming the generated A C to transmission voltage, rectification to high voltage D C , inversion from D C to A C at the receiving end and finally transformation back to low voltage A C for consumers One of the main advantages claimed for D C transmission is that the line insulators having to withstand the crest voltage in A C , the same line can transmit at least 40% more power at D C The system of course requires more equipment and is therefore economical for long distance transmission of large power It has been estimated that this method is suitable for distances greater than 300 miles and power greater than 300,000 kw

Safety Devices

Electronic safety devices are available for protection of goods, property and life, for giving warning of improper operation of equipments and many other purposes Burglar and fire alarms, are the simplest examples In a punch press or other hazardous machines, if the operator presses a lever before taking out his hand from under the punch, his hand will perhaps be smashed instantly Photoelectronic devices have been developed which keep the machines locked till the hand is removed In modern gas-fired industrial ovens an electronic safety device, consisting of a thermocouple, influenced by the pilot flame alone, shuts off the fuel supply and gives an alarm

signal when the pilot light fails due to failure of power, fuel or air supply Similarly safety devices are available to give warning of incomplete combustion in a Diesel engine, the indicator being the exhaust smoke density

In many industrial plants the pollution of air with dust and metal particles is a serious menace to the workers' health and to the machinery involved Mechanical filters are only partially effective The latest electronic device, called the precipitron, is capable of removing 90% of these particles The polluted air is first passed through an ionising space consisting of fine tungsten wires placed between parallel tubes A rectifier giving about 13 k v D C is connected between the tubes and the ionising wires, the latter being positive The dust particles passing through the ioniser become positively charged and then pass through a precipitator consisting of a row of metal plates charged alternately positive and negative to about 6 k v supplied by another rectifier The charged particles are then deposited on the negative plates Electronic air cleaning is now being used for blood plasma evaporators, for removing toxic welding fumes from industrial locations and clearing dangerous oil mists from rooms where high speed machine tools are operated The use of precipitron during the war greatly reduced such machine troubles and also enabled recovery of much oil

Minute traces of mercury vapour in the atmosphere of metal mining, smelting and some chemical plants are a serious menace to the health of workers Accurate electronic equipments have lately been developed to detect and instantly signal the presence of such poisonous gases Air is drawn through a chamber containing a photocell and an ultraviolet lamp The presence of mercury vapour scatters the light falling on the photocell and thereby decreases its current which is indicated by a bridge type detector

Production Test Uses

Electronics has provided various devices to the industries for production testing such as counting, sorting, weighing, etc A simple counting device incorporates a photocell operating a thyratron A relay in the plate circuit of the thyratron, in turn, operates a mechanical counter Electronic counters are being increasingly used for counting packages of cereal, pieces of metal, cars entering or leaving a garage, and so on

The colour consciousness of the photocell has been utilised to perform various acts of sorting and grading and maintaining uniformity of finished products In roasting coffee beans, for example, a beam of light falls on the beans through a window in the roaster and the reflected light is compared with that from a standard sample by means of photo cells This method is also used in manufacturing inks, dyes, syrups, etc

In cement industry again, the raw materials are burnt in large rotary kilns The kiln drive is to-day automatically controlled by a photoelectric device and temperature maintained at the desired preset value This has resulted in a better and more uniform cement at a lower cost

In canning industry the detection of pin holes in metal sheets is an essential job The common practice had been visual inspection of any light penetrating through the sheets while passing on the conveyor, a strong source of light being kept under the sheets The process was tedious and, for accurate check, the speed of the conveyor could not be made greater that 50 ft per minute Electronic pin hole detectors utilising phototubes have increased the speed to as high as 1000 ft per minute

Electronic devices are also available for detecting cracks in metal wire, tubing and bars at mass production speed A block diagram of a typical arrangement is shown in Fig 6 The material is passed

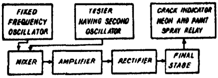

FIG 6 Block diagram of electronic crack detector A crack changes the beat frequency produced by the mixer and thereby causes a large variation in rectified voltage This operates the indicator

through the field of inductance of one of a pair of oscillators in the tester and a beat frequency is produced The beat frequency voltage is rectified to operate a meter, a neon flasher and a relay A crack changes the beat frequency causing a large variation of rectified voltage This causes the meter to flick, the neon to flash and the relay to close The relay operates a small compressed air paint sprayer which automatically identifies the faulty material

Various inspection works in the metal industry are now being done with X-rays These provide very effective tools for non-destructive testing of such defects as blow holes, inclusion bubbles, cracks, shrinkages, etc The pre-war industrial X-ray equipments were bulky and less powerful The War saw the development of compact and more powerful equipments with which steel plates as thick as 8 inches can be inspected in about 15 minutes Such work could be done by pre-war low voltage equipments in not less than 60 hours. Thickness of white hot steel sheets coming from a rolling mill at a speed

of 1500 ft per min can now be accurately measured by X-rays X-ray machines now inspect and automatically sort out hand grenade fuses at the rate of 4000 per hour If a fuse has insufficient powder a visible and/or audible sound is given and a blot of red paint sprayed on the defective fuse for subsequent identification Formerly, shells were inspected by making destructive tests on samples taken from a lot If a major defect were found in one, the whole lot used to be rejected High voltage X-ray equipment can now quickly examine each individual shell and the test being non-destructive, this saves much ordnance

Lower power X-ray equipment (68 kv, 4 Milliamps) is also used for fluoroscopic detection of defects and presence of foreign matter like nails, etc in automobile tyres X-ray fluoroscopy is also used for examining packaged food products

Molecular Vibration Uses

Supersound, generated by electronic apparatus and capable of inducing molecular vibration, has also found many industrial applications This is used, like X-rays, for many non-destructive tests In the rubber industry supersonic waves are widely used for testing finished tyres, specially for air bubbles Germs and bacteria are killed and milk pasteurised in a few seconds by supersonic waves When such waves are passed through milk the bacteria are killed in a much smaller time than that in heat pasteurisation The milk is also thereby homogenised due to breaking up of fat or cream globules into minute suspended particles When air is subjected to supersonic waves the solid particles of smoke and dust tend to coagulate and drop Fog in air ports and such other vital places may be cleared in future by coagulation of vapour particles in this way These waves are also used to break up red blood corpuscles and release their hemoglobins They also release the enzymes from bacteria Formerly, the bacteria had to be killed for this purpose but now they are vigorously shaken by supersounds and the enzymes are thereby freed

Although supersounds kill some bacteria they have some stimulating effect on others Certain bacteria responsible for aging of wine are so stimulated by supersound that this gives an easy means of aging wine

Measurements and Analyses

In regard to measurements and analyses in various industries it may be said in general that whenever small quantities are to be measured or detected electronic devices are the quickest and the best The electron tube, because of its amplifying property and negligible inertia of the moving element, offers immense advantages for various measurements If the quantity to be measured is electrical in nature and specially if it is small in magnitude the electron tube will provide one of the most powerful tools Many devices are available for converting the variation of a non-electrical quantity into its electrical counterpart and when this is done the electron tube will readily measure it In many industrial operations, measurement of strain is very important The resistance and inductance type strain gauges, acting in conjunction with sensitive electronic devices, have been found to be very useful for such work Strain gauges are used for studying strains on boiler plates, aircraft structures, bridge piers, walls, dam structures, etc In rolling mills, strain gauges are so arranged as to give an alarm signal when the machine is overloaded

Like strain, displacement, pressure and vibration in industrial problems are readily measured by electronic means, the quantity to be measured being first converted into its electrical equivalent by a suitable device Thermoelectric and photoelectric devices are widely used for measuring and recording temperatures

Thickness of industrial coatings like paints, of paper, cloth, plastic sheets, etc , is readily measured and controlled by electronic means This is easily done by making the measurable quantity change the capacity of a condenser system with which it is linked

Viscosity in many industrial processes is now measured accurately by electronic means The falling ball method has been successfully applied to dark liquids by electronic methods In processes where viscosity changes continuously with operating conditions, a dynamic viscometer has been developed in which the amplitude of vibration of a body under constant driving force is measured

The *p*H meter is now a well known measuring equipment used in many industrial problems for determining the degree of acidity or alkalinity The *p*H meter has also been utilised for humidity determination, titration work, etc

The cathode ray oscillograph has become one of the most versatile measuring instruments to-day The use of electron microscope for studying the surface structures of metals and insulators, as also of microbes and bacilli also deserves mention in this connection

From this brief survey of the applications of Electronics in Industry it will be amply evident that Electronics has definitely speeded up production, improved the quality of the products and has made

industry more efficient Electron tubes are now capable of performing almost all the functions of the five senses and there is perhaps no industry which cannot profitably employ electronic devices There are many industries in which jobs which have so far been made by non-electronic means are now being done in a much better and quicker way by means of electronic devices

It must however be admitted that for various reasons the Indian Industry to-day is not in a position to fully utilise the advantages offered by such devices But since we are on the threshold of large scale industrial development it is necessary that our industrialists should be aware of these advantages Techniques of many industrial processes have been revolutionised by the development of electronic equipments in recent times Without utilising these devices our industries will never be able to keep the rate and standard of production equal to those of the Western countries

THE INDIAN CEMENT INDUSTRY

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CEMENT was unknown about century and a quarter years back Before the advent of cement other ingredients were used instead, and the ancient buildings and monuments stand testimony to the strength of those ingredients But cement (meaning concrete) holds the field today Whether roads or bridges, houses or household goods, godowns, or granaries, concrete is used for all construction purposes Cement has thus an important position in the building materials required for the reconstruction and industrial development of India

HISTORY

The Indian Cement Industry is hardly fifty years old It was first manufactured in Madras in 1904, and three cement factories existed in 1913 During the Great War (1914-18) their production increased from a thousand tons to 84 thousand tons The imports decreased from 151,000 tons to 20,000 tons during the same period The three companies reaped enormous profits, and the country was self-sufficient to the extent of 81% of its consumption of cement by the end of the War

The following table summarises the position during the Great War —

(In thousands of tons)

Year	Imports	Production	Consumption	Percentage of production to consumption
1914	151	1	152	0 67
1915	126	18	144	12 5
1916	81	39	120	33 0
1917	70	74	144	51 4
1918	20	84	104	80·8

Peace brought more imports, and more companies too Seven new companies started production during 1919-22 Although the consumption of cement increased, there was an over-supply due to imports and internal over-production Prices decreased and production fell much below the total production capacity In 1925, India imported only 68,000 tons of cement She produced 361,000 tons, though the production capacity was 451,000 tons In other words, twenty per cent of our production capacity was unused

During 1925-30 the imports were rather stable Internal production of cement increased though at a decreasing rate It stood at 564,000 tons in 1930 The use of cement also went up from 429,000 tons in 1925 to 636,000 tons in 1929 The next year the consumption declined by about 4,000 tons Our production was still below the production-capacity An idea of the surplus production-capacity can be got from the fact that the 10 companies of 1925 had increased their production-capacity to 820,000 tons in 1930-31, that is, about 50% above the total production of cement Clearly, the cement industry was falling on evil days, but there were certain silver linings to the otherwise dark clouds

TARIFF BOARD

In 1924, the cement industrialists applied to the Government of India for protection against foreign competition A Tariff Board was appointed Due to the existence of a destructive rate-warfare among the Indian cement producers, the Tariff Board did not recommend any protection, though it was not averse to the grant of a bounty It advised the producers to cooperate in the field of marketing.

However, in 1926 the Government of India charged the import duty on cement from 15% *ad valorem* to rupees nine per ton The same year the cement producers established an Indian Cement Marketing Association In order to find new uses of cement and to popularise its use, the Concrete Association of India was created in 1927 In 1930 the Marketing Association was replaced by the Cement Marketing Company of India Limited It arranged the sale of cement from different companies on a quota basis The amount to be sold for each company was fixed on the basis of its previous sales

The Marketing Company did well till 1935 Then it was found that under the new system not infrequently cement was supplied in the markets from distant companies, although some company located nearby could have undertaken the supply easily and at cheaper cost An improvement was therefore considered essential

The Associated Cement Company

Consequently, in 1936 the various cement companies combined to form the Associated Cement Company It had four important objectives —

(i) To organise sales in the most advantageous way ,

(ii) To regulate production in relation to demand for effecting economies in production and distribution costs ,

(iii) To improve the industry by developing production in suitable localities , and

(iv) To control production in unsuitable areas

Economic Depression

There was an economic depression in 1931, which reduced the internal production of cement still below the production-capacity In 1936, factories were started by the Dalmia Managing Agency in the different parts of the country Dalmia claimed that the cost of production could be further reduced and thus the consumption of cement can be increased For some years there was a destructive competition between the two rival groups though they were not equally matched so far as production-capacity was concerned, as is clear from the distribution of the production-capacity before World War II shown below —

Name	Production-capacity (In lakhs of tons)
A C C	18 6
Dalmia	5 6
Others	3 6
Total	27 8

Fortunately for us, they have now compromised. However, the production and consumption of cement in the country continuously increased during 1931-39, particularly after 1936 In 1938-39, the import was 21,000 tons, the production 1,512,000 tons and the consumption 1,533,000 tons This was about two and a half times of the 1931 position, except with regard to import which was one-third of what it was in 1931

Among the industries developed in India in this century, the cement industry deserves a special mention In 1940-41, we imported only 4 3 thousand tons of cement costing Rs 6 lakhs The same year we even exported some cement The A C C already has on hand orders for exports of cement The exports are mainly to countries like Iraq, Celyon and the Dutch East Indies Within forty years the industry has been developed into an exporting industry During World War II, the production-capacity of the cement industry was 2,782,000 tons, though the annual production never exceeded 2,250,000 tons (1941-42) Since 1942, the production has been continuously decreasing

Capital

Although there has been much undersirable competition between the different cement producers in India, the cement-companies have distributed high profits In peace time the cost of production was estimated to be about Rs 25-30 per ton and the market price was generally not below Rs 45 per ton There was therefore a margin of about Rs 15 per ton It is estimated that with proper organisation a cement factory can return its capital in five years Today the reserve fund and the share capital invested in the industry amount to about Rs 17 crores

Labour

Twenty-five years ago the industry employed 5,000 workers In 1939, the number had increased to 10,000 Today it exceeds 25,000

The percentage distribution of the industry by labour force underwent *a change* between 1925 and 1937 The industry became more dispersed as is clear from the following table —

Province	Percentage distribution of labour	
	(1925)	(1937)
C P	35 8	31 8
Punjab	15 2	13 0
Bihar	9 7	16 9
Madras	—	2 3
Rajputana	28 0	17 8
Hyderabad	—	9 2
Baroda	—	3 6
Bombay States	11 3	5 4
	100 0	100 0

As a result of the enquiry recently made by the Rege Committee, it was found that the majority of the workers are not skilled workers Really, the cement companies do not require skilled workers Consequently, the wages are not high One-third of them earn between 8-12 annas per day and 61 47% do not get even a rupee per day Apart from low wages, the cement workers are better placed than other industrial workers, particularly with regard to housing, social security and welfare Due to plenty of land and own-supply of cement, satisfactory arrangement exists in regard to housing of the labourers In addition, arrangements have been made for medical care, education, games including indoor games and even cheap grain shops The facilities are better provided by the A C C group An aid-fund is being organised for help to the worker in times of need There is also provision for provident fund and service gratuity In the Dalmia group, there is provision only for provident fund, and that too for workers earning more than Rs 25 per month This is undesirable and should be remedied The cement worker is therefore well off except in regard to his wages

Size of the Firms

Before we deal with the present problems and the future planning of the industry, it is advisable to say something about the size of the different companies and the location of the industry Business considerations demand that the size of the firm should conduce to minimum cost The Tariff Board (1925) was of the opinion that the purpose would be served if each factory has two furnaces and a production-capacity of 40,000 tons At that time the number of companies was small and each got an opportunity to serve a good portion of the country's demand It may be argued that as the number of factories increase, each shall have a smaller market to serve and that this shall affect the size of the factories But we must not ignore the fact that the demand for cement is increasing by leaps and bound So, though each factory may serve a small area, it may have a considerable demand Till now, of the twenty-three factories, the greatest number, *i e*, six had a production-capacity between 60-80 thousand tons But twelve factories had a production-capacity exceeding 100 thousand tons Of the twelve, nine had a production-capacity over 150 thousand tons each The tendency is clearly towards a unit of 100,000 tons capacity

Location

The location of the industry has been rather unevenly distributed Both in regard to the total production and the number of factories, a major portion of the industry has been concentrated in four provinces, *viz*, Bihar, Madras, Sind and Punjab Production has not been so far undertaken in U P, Orissa, Bengal and Bombay C. P too has not produced much This does not mean that cement cannot be produced in these regions The situation is being remedied in the new planning of the *present* Government of India Out of 15,50,000 tons of the additional capacity for which a plan has been made, 650,000 tons, *i e*, about two-fifth have been allotted to these provinces

The distribution of the additional production-capacity in present India, is as follows —

Province	Additional production capacity, (in lakh tons)
Bombay	300
Bihar	200
Assam	100
C P	100
U P	100
Orissa	100
Bengal	50
Indian States	600
Total	1550

In U P the construction of a cement plant costing Rs 2 crores has been placed with Messrs Vickers Armstrong Ltd It will be installed near Markundi, south of Robertsganj in the Mirzapur District to produce 700 tons of cement per day The lay out of the plant will provide for extensions to produce up to 1,400 tons per day The plant is expected to function fully after 1950-monsoon The limestone deposits at Markundi are sufficient to last for 50 years In the vicinity there are deposits of limestone to last this plant for centuries

Three factors have to be considered to determine the location of the industry—raw materials, source of power and the market Of the three essential raw materials, *viz*, limestone, loam and gypsum, the first two are widely distributed in the country and can be found near the railway lines That is why the companies are generally located near the railways Gypsum has to be fetched from a distance but the cost is not high C P has had raw materials and markets too, but its importance shall decrease with the development of hydroelectricity So far as the third factor, market, is concerned, there was a time when, in order to avoid foreign competition, our factories were located away from the ports and supplied only the internal markets. This danger is no longer important The industry is tending to distribute itself, not only with regard to the Indian provinces but also the Indian States, which are also allotted about two-fifth of the additional planned production-capacity.

FUTURE PLANNING

Before the division of India the State had planned for an additional production-capacity of 31 lakh tons of cement Of the twenty-three companies, fifteen were to increase their production-capacity, and nineteen new companies were to be established Twenty-one companies had placed their orders in England, Denmark and America It was estimated that by 1952, when the public and the government would require 40 and 20 lakh tons of cement respectively, we shall be able to meet the demand from internal production The original plan was to produce 60 lakh tons of cement in 1952 This has been reduced to 50 lakh tons after the division of the country

PRESENT PROBLEMS

At present cement is not available easily and at low price This is partly due to difficulties of distribution and partly due to the high cost and uncertainty of production In 1942 the Central Government had instituted a control and taken 80% of the cement for military use Although with the expiry of the Defence of India Rules, the Central control has gone, the provinces still exercise a control on the production and distribution of cement The situation shall ease as the control is withdrawn

As to the high cost of production, wages have gone up Also, the price of jute bags has increased, and it is unfavourably affected by the division of the country and the imposition of an export duty on raw jute by Pakistan

Another difficulty is the uncertainty of the transport of coal For every ton of cement, there is required one-third ton of coal At this rate for a production of even 21 lakh tons of cement, about 60,000 tons of coal are needed per month Recently, coal has not been available at more than 40-45 thousand tons per month The government of India is making efforts to solve the problem of transport but there is not much hope Therefore, one would not be surprised if the production of cement decreases further

From the point of view of increased production, a third bottleneck is the lack of machinery During the war, cement plants have been used under pressure and have depreciated On the other hand, new machinery has not been imported To get over this difficulty, some factories have started manufacturing their own machinery Even so, we have to import, from U S A , England, Denmark and other foreign countries, such machines as power-plants, boilers, reduction gears and electric motors The sooner we get them, the faster shall our production increase

MULTIPLICATION OF CHROMOSOME NUMBERS IN RELATION TO SPECIATION IN ZINGIBERACEAE

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THE family Zingiberaceae with 45 genera and about 800 species (Willis, 1931) is chiefly Indo-malayan in distribution The genera *Costus* and *Renealmia* are exceptions, being mostly confined to the western hemisphere India contains 21 genera and more than 200 species (Hooker, 1894).

As compared to the large number of species belonging to this family chromosome numbers of only a few have so far been recorded. Chromosome numbers of 31 species spread over 9 genera including the work done by Raghavan and Venkatasubban (1943) are on record In addition the chromosome numbers of 11 species have been determined by the author and in the following table, the chromosome numbers of 42 species belonging to 9 genera of Zingiberaceae are shown. The data, though they may appear to be inadequate, bring out clearly certain interesting features in relation to polyploidy as a means of speciation in the family

CHROMOSOME NUMBERS IN ZINGIBERACEAE

Species	Somatic Chrom No	Meiotic Chrom No	Author	Year
1 *Zingiber officinale* Rosc	22	—	Sugiura	1928
	22	—	Morinaga *et al*	1929
	24	—	Takahashi	1945
	22	—	Raghavan & V*	1943
	22+21	—	Janaki-*Ammal*	1945
	22	—	Chakravorti	1947
2 *Z cassumunar* Roxb				†
	22	—	Raghavan & V	1943
	22	11	Chakravorti	1947
3. *Z zerumbet* Sm	22	—	Raghavan & V	1943
	22	11	Chakravorti	1947

CHROMOSOME NUMBERS IN ZINGIBERACEAE—*Contd*

	Species	Somatic Chrom No	Meiotic Chrom No	Author*	Year†
4	*Z rubens* Roxb	22	11	Chakravorti	1947
5	*Zingiber* sp	22	11	Do	1947
6	*Z mioga* Rosc	55	—	Morinaga *et al*	1929
7	*Alpinia calcarata* Rosc	48	—	Raghavan & V	1943
		48	24	Chakravorti	1947
8	*A bracteata* Roxb	48	24	Do	1947
9	*A allughas* Rosc	48	—	Raghavan & V	1943
		48	24	Chakravorti	1947
10	*A malaccensis* Rosc	48	24	Do	1947
11	*A aquatica* Rosc	48	24	Do	1947
12	*A vittata* Bull	48	—	Raghavan & V	1943
13	*A nutans* Rosc	48	—	Do	1943
		48	24	Chakravorti	1947
14	*A galanga* Sw obs	48	—	Raghavan & V	1943
15	*Elettaria cardamomum* Manton		24	Gregory	1936
		52	—	Chakravorti	1947
16	*Phaeomaria atropurpurea*	-	24	Boehm	1931
17	*Kaempferia atrovirens*	22	11	Chakravorti	1947
18	*K Gibsoni*	24	—	Raghavan & V	1943
19	*K Gilbertii* Bull	36	—	Do	1943
		33	—	Chakravorti	1947
20	*K rotunda* Linn	54	—	Raghavan & V	1943
		33	—	Chakravorti	1947
21	*K cienkowskya* (?)	28	—	Do	1947
22	*K Galanga* Linn	54	—	Raghavan & V	1943
23	*Curcuma aromatica* Salisb	42	—	Do	1943
		42	—	Chakravorti	1947
24	*C amada* Roxb	42	—	Raghavan & V	1943
		42	—	Chakravorti	1947
25	*C angustifolia* Roxb	42	—	Do	1947
26	*C longa* Linn	64	—	Sugiura	1931
		62	—	Raghavan & V	1943
		62, 63, 64	Irregular	Chakravorti	1947
27	*C Zedoaria* Rosc	63, 64	Do	Do	1947
28	*Hedychium flavescens* Cau	34	—	Raghavan & V	1943
29	*H Greenii*	36	--	Do	1943
30	*H flavum* Roxb	52	--	Do	1943
31	*H coronarium* Koen	54	--	Do	1943
		54	-	Chakravorti	1947
32	*H Gardnerianum* Rosc	54	--	Raghavan & V	1943
33	*H gracile* Roxb	66	—	Do	1943
34	*H Elwesi* Baker	66	--	Gregory	1936
35	*Globba bulbifera* Roxb	48	—	Raghavan & V	
		48	Irregular	Chakravorti	1947
36	*Costus cylindricus*	—	8	Boehm	1931
37	*C malarotiensis*	18	—	Gregory	1936
38	*C igneus* N E Br	18	-	Raghavan & V	1943
39	*C discolor*	18	—	Do	1943
40	*C speciosus* Smith	36	18	Banerji	1940
		36	—	Raghavan & V	1943
		36	18	Chakravorti	1947
41	*Costus sp*	36	18	Do	1947
42	*Costus sp*	44	—	Do	1947

* Raghavan & V stand for Raghavan & Venkatasubban

† The year indicates the period during which this work was completed and received for publication

The different species of *Zingiber* show different chromosome numbers, such as, $2n=22$, $22+2f$, *24* and *55* The present observation in *Z officinale* with $2n=22$ chromosomes is in conformity with that of Raghavan and Venkatasubban (1943) The number $2n=24$ as reported for this species by Takahashi (1945) is most likely due to the presence of 2 extra fragments as recorded by Janaki-*Ammal* (1945)

In view of the normal pairing of chromosomes forming 11 bivalents in species like *Z cassumunar*, *Z zerumbet* and others, *Z mioga* with $2n=55$ chromosomes is to be considered as a pentaploid species The intermediate numbers, such as, $2n=33$ and *44* have yet to be found It is interesting to note that though most of the species of *Zingiber* are Indo-malayan, some of them have spread as far north as China and Japan The genus has also migrated to Mascarene and Pacific Islands (Rendle, 1930) That the migration of species of *Zingiber* northwards has resulted in the evolution of polyploid species is exemplified by *Z mioga* with $2n=55$ chromosomes This species occurs in Japan Evolution of polyploid species concurrent to migration has been reported in different plant genera (*cf* Tischler, 1937 , Babcock, 1942 , Anderson, 1937 , Strelkova, 1938 , Manton, 1934 , Beatus, 1936)

The genus *Kaempferia* also shows clear evidence of polyploidy *K atrovirens* with $2n=22$ chromosomes is a diploid species showing normal pairing and 11 bivalents *K rotunda** and *K Gilbertii* on the other hand are triploids with 33 somatic chromosomes The nature of polyploidy in these two species *i e*, whether they are allo- or autotriploids will be ascertained later from an examination of their pollen mother cells.

K cienkowskya† *has* $2n=28$ chromosomes According to Raghavan and Venkatasubban (1943) *K rotunda* and *K Galanga* both have $2n=54$ chromosomes Whether these species are hypotetraploids derived from species like *K cienkowskya* ($2n=28$) or are true tetraploids with $2n=56$ chromosomes instead of *54* should be decided after a careful re-examination of both the species Similarly, there are reasons to doubt whether *K. Gibsoni* and *K. Gilbertii* have $2n=24$ and $2n=36$ chromosomes respectively as reported by Raghavan and Venkatasubban or whether the correct numbers should be $2n=22$ and $2n=33$ respectively as found in some other species of the genus referred to above

* Plants under the name of *K. rotunda* investigated by the present author were obtained from the Royal Agri-Horticultural Society of India, Alipore. Whether there are polyploid forms of the species occurring in nature is not yet known

† The identity of this species is doubtful Rhizomes under the name of *K cienkowskya* were supplied by the Royal Agri-Horticultural Society of India, Alipore

The genus *Kaemferia* therefore, has in all probability two distinct polyploid lines based on $n=11$ and $n=14$

In the genus *Costus* there are different species *18, 36* and *44* The *36*-chromosomed species appear to be tetraploid forms of the *18*-chromosomed ones Banerji (1940) has observed normal pairing and 18 bivalents in *C speciosus,* which indicate that the species is either an amphidiploid or a balanced allotetraploid The unidentified species of *Costus* (*cf* Table) having *44*-chromosomes is probably an allopentaploid form ($5x=8+36$) produced by the union between a normal gamete of a species like *C cylindricus* ($2n=16$) and an unreduced gamete of the *36*-chromosomed tetraploid species A study of meiosis of the *44*-chromosomed species will throw further light on this problem

In the genus *Curcuma, C aromatica, C amada* and *C angustifolia* all have $2n=42$ chromosomes, whereas species like *C longa* and *C Zedoaria* have 63 somatic chromosomes The latter 2 species are therefore, triploid species Meiosis of *C Zedoaria* has furnished additional support to this contention Reports of other numbers, namely, *62* and *64* found occasionally in *C longa* and *C Zedoaria* can best be explained as being due to somatic aberrations (*cf* Kihara, 1921 , Belling & Blakeslee, 1924 , McClintock, 1929 , Larter, 1932 , Agharkar & Bhaduri, 1935 , Cheesman & Larter, 1935 , Bhaduri & Sarma, 1946) This condition is particularly prevalent in those plants which are mainly propagated by vegetative means

According to Raghavan and Venkatasubban (1943) *Globba bulbifera* with *48* somatic chromosomes is likely to have originated from a basic number *12,* and hence the species is to be regarded as a tetraploid The meiotic behaviour of chromosomes and pollen analysis of this species however, clearly indicate that it is an autotriploid ($3x=48$) and not a tetraploid species (a detail cytological account of this species will be published elsewhere) Further examination of different species of *Globba* especially those growing at high altitude or those still restricted to their home area *i e*, Indo-Malayan region, will not only reveal the existence of true diploid species ($2n=32$) but may also show the occurrence of other polyploid types The genus is fairly large containing 72 species and is distributed chiefly in the Indo-Malayan area (Rendle, 1930)

The occurrence of a high chromosome number in many of the species belonging to other genera, namely, *Alpinia, Phaeomeria* and *Hedychium* though suggesting that they are polyploids, is in reality not so A critical morphological analysis of the chromosomes as well as their meiotic behaviour in different species of the above genera have suggested (a detail account will appear elsewhere) that they are neither polyploids nor amphidiploids, but the increase in number of their chromosomes has been brought about by fragmentation of some chromosomes of other closely related genera at the region of supernumerary constrictions which are so prevalent in the chromosomes of species of *Zingiber* and *Kaempferia* (*cf* Chakravorti, 1948) Thus, the latter two genera having longer chromosomes but smaller in number with unusually large number of secondary constrictions have very likely contributed to the origin of the different species of *Alpinia, Curcuma* (diploids), *Hedychium* and others, all of which have comparatively high number of chromosomes which are smaller in size and with fewer supernumerary constrictions Clear evidence of increase of chromosome number through fragmentation has been obtained in several genera in the allied family Musaceae (Chakravorti, 1948), and also in *Cucumis* (Bhaduri & Bose, 1947) and *Salix* (Wilkinson, 1944)

The different species of *Hedychium* show different chromosome numbers ranging from $2n=34$ to $2n=66$ and form a typical aneuploid series The origin of these aneuploid numbers has most probably resulted as a consequence of fragmentation of chromosomes in some of the parental forms with fewer but longer chromosomes having many supernumerary constrictions

Though the data at hand are not sufficient to indicate a basic number for the family, it is in all probability not *6* as suggested by Raghavan and Venkatasubban (1943) The lowest number uptil now recorded in the family is $n=8$ in *Costus cylindricus* The genus *Costus* again from the cytological standpoint, is quite distinct from the rest of the genera examined It may be noted that taxonomically also this genus belongs to a distinct subfamily, *Costoideae,* while the remaining genera investigated so far belong to the second subfamily *Zingiberoideae* The lowest number recorded in the latter subfamily is $n=11$ Whether there are two separate basic numbers and two corresponding lines of evolution in the family *Zingiberaceae* can only be confirmed when more data will be forthcoming *

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* My thanks are due to Dr P N Bhaduri of the Department of Botany, Calcutta University, for his helpful criticisms, and to Mr S Percy Lancaster, Secretary, Royal Agri-Horticultural Society of India, Alipore, for supplying me with some of the species used in this investigation

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AIRCRAFT TURBOJET PROPULSION

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NEWTON'S third law of motion that action is equal and opposite to its reaction forms the fundamental operating principle of any propulsion mechanism The conventional airscrew used in aircrafts, is merely an arrangement for converting the rotary power developed by the engine into a forward thrust on the plane and this it does by pushing backwards a large mass of air which, in aeronautical parlance is called the slip stream The forward thrust on the airscrew is equal and opposite to the force propelling the slip stream, which is equal to the momentum created, (*i e* the product of the slip stream mass flow and the velocity) In the conventional airscrew the propulsive thrust can be varied by changing the pitch and/or speed of the propellers With the development of higher aircraft speed, it was found that airscrew efficiency was maintained only upto about 350 to 400 m p h and fell off considerably above these values This is due to the fact that at high airplane speed, the speed of the tips of the propellers, not only equals, but even exceeds the speed of sound in air When this occurs, the normal streamline or laminar flow over the blade sections breaks down and a "shock wave" is formed, which is directly responsible for reducing the airscrew efficiency To eliminate this defect, a new method of propulsion has been devised whereby the limits imposed by the formation of airscrew shock waves are suitably overcome This method, which is now regarded as a milestone in aeronautical achievements is called Jet Propulsion

FUNDAMENTALS OF JET PROPULSION

In its simplest form a jet propelled aircraft contains one or more ducts running parallel to the longitudinal axis of the plane As the aircraft moves forward, an airstream passes through the duct, across a mechanism usually a combustion turbine and comes out from the tail As the purpose of the turbine is to increase the speed of the air stream, it follows that the speed of the stream, relative to the aircraft is greater at the outlet of the duct, than at its entrance Now since the speed of the stream is increased, its momentum is also increased, and in order to accomplish this it is necessary to apply a force to the air in a rearward direction This force is applied by the combustion turbine The procedure described above is only explanatory, because actually it is the reverse that holds true in practice Thus since action and reaction are equal and opposite, it follows that if the turbine applies a force to the air, an equal and opposite force is exerted on itself, that is, in turn on the aircraft It is this reactionary thrust that provides the necessary propulsive force for the airplane It can therefore be easily realised that the heart of a jet propelled plane is its turbine mechanism—a plant on whose efficiency the whole performance of a jet plane depends In such a turbojet plane, the conventional horsepower is no longer a measure of propulsive achievement Unlike the ordinary engine of pistons and cylinders which has a constant energy output expressed in horsepowers, a turbojet plane's performance is measured by its thrust One pound thrust equals one H P at 375 m.p h This means that an engine of 4000 pounds thrust develops the equivalent of 4000 H P. at 375 m p.h or 8000 H P at 750 m p h The most staggering example of this is the 14 ton German V-2 rocket which exerts 58,000 pounds thrust to take off, then accelerates upto 3500 m p.h. by developing the equivalent of 600,000 H P — an achievement only possible through jet propulsion principle A typical jet unit of the type of de

Havilland Goblin II (as fitted to the de Havilland Vampere Fighter) comprises of a compressor which draws cold air from the wing air intakes and after compressing it to about 40 lbs /sq″ supplies it to a series of combustion chambers where fuel is injected and burnt. The expanding mixture of air and combustion products drives the turbine and is then ejected rearward with great residual energy. The graph (Fig. 1) gives a vivid idea of the propul-

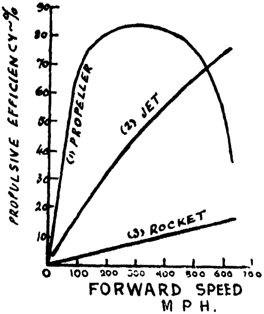

FIG. 1. Propulsive Efficiency of Aircrafts

sive efficiency of a typical aircraft flying at 20,000 ft. (1) with airscrew arrangement, (2) with a jet propelled plant, (3) as a rocket. It will be observed from this graph that the efficiency of the jet equals that of the airscrew only after a speed of 550 m.p.h. has been reached. However for higher altitudes say 30,000 ft. this 'target' speed would reduce to 450 m.p.h. Effective use of the jet principle utilizing atmospheric air for the thermodynamic cycle and as a produlsive agent as well, requires an engine capable of handling large flows of air but proportionately light in weight. The turbojet engine with turbine driven centrifugal or axial flow compressors meets these requirements to a high degree.

Varieties of Jet Propulsion Motors

There are several varieties of jet motors available such as the Impulse-Duct Jet motor, which works on an explosion cycle and which with certain modifications, was used in the pilotless German aircraft, better known as the flying bomb of the type F Z C 76, the Constant Pressure Duct Jet motor, which considered purely as a jet propulsion unit has only an academic value because of its very low overall efficiency although the principle of the system has an important application in the ducted radiators employed in liquid cooled reciprocating aero engine-installations, and the Combustion Turbine Jet motor which is the present accepted type of jet propulsion motor used in modern aircrafts. In this type the overall efficiency of the plane is primarily dependent upon the efficiency of the turbine. It was in this form that the distinguished English designer Air Commodore Sir Fank Whittle first put up his ideas on a unit which now bears his name. It would be out of place to describe the Whittle Jet Propulsion Turbine, again in this article, as this subject has been very well described in many papers presented before the Royal Aeronautical Society and The Institution of Mechanical Engineers (London), The Institute of Aeronautical Sciences, U.S.A., and in other engineering journals. Very briefly it may be stated that in the Whittle system the source of power is an internal combustion turbine which gives its output not as shaft power, but in kinetic energy of the working fluid, which is expelled rearwards to form the jet. Comparing this system with the one developed by the Italian engineer, Campini, it may be stated that the latter's piston engine is replaced by the internal combustion turbine, the jet air compressor is combined with that for the turbine unit, while Campini's fuel burning arrangements are rendered redundant, as the air is heated in the combustion chamber before the turbine. Of all the developments the Whittle system is the simplest, (except perhaps the flying bomb engine or thermal duct units,—not considered here) and one which is becoming the most popular for jet propulsion.

Developments in Jet Propulsion

The main drawback of a jet engine in its present state is its excessive fuel consumption. Nevertheless this disadvantage has to be considered and carefully weighed against the other outstanding attractions such as very high speeds, simplicity of design, ease of manufacture and maintenance, reduction in overall weight, sound, and size of undercarriage, absence of drag due to slip stream on wings, and of reciprocating parts, meaning less vibration, and lighter engine mountings and simpler control systems. The question of fuel economy appears to favour the development of the turboprop—a plant incorporating a turbine and a propeller—which one school of thought believes to be the first and logical step towards jet power. Calculations reveal that the disadvantage of turbojets, in developing maximum power only at top speeds, is practically completely eliminated by turboprops having economical cruising speeds between 350 to 450 m.p.h. Britain has gone

one step even beyond the turboprop, by devising the turbo fan (or ducted fan) which employs a bladed wheel to add a second jet stream and thus increase the thrust and take-off power for speeds between 400 and 500 m p h Thus by the end of this decade the progress in aircraft propulsion will have advanced to such a stage that the reciprocating propeller engine will be used for light planes upto 300 m p h , the turboprop or turbofan for extreme long range transports at 300 to 500 m p h , and pure turbojet engines for high, fast and short hauls above 500 m p h That is not all The magnificent developments in rocket propulsion are also affecting the progress of aero engines, for in order to fly very fast and very high, jet propelled engines have to give way to the pulsejet, the ramjet and finally the pure liquid fuel rocket The pulsejet reaches 1000 m p h , the ramjet 1500 m p h and the rocket 3500 m p h Germany put the first jet fighters into combat in 1943, the first pulsejet engines soon after, and was no less than ten years ahead of all other countries in the development, production and launching of the high-thrust liquid fuel rockets Britain was almost concurrent in turbojet development, and since November 1945 has held the official world's speed record of 606 m p h set by the jet propelled Gloster Meteor Strange as it seems America has lagged behind in jet propulsion and it is only since the last few years that she is trying to catch up with her contemporary nations The study and development of propulsive power is vividly brought to light by Dr Fritz Zwicky, a brilliant Swiss technologist in his Morphological Chart, (Fig 2) A

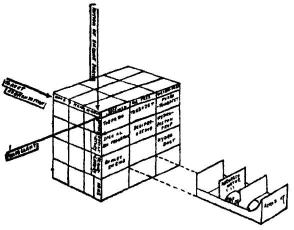

FIG 2 Morphological Chart of Propulsive Power Plants activated by chemical reactions

study of this chart will unfold its three-dimensional nature represented by the general character of the propellant, motion of engine parts, and type of thrust By pulling out any drawer in the file cabinet, each compartment will be found to contain a particular engine or one still to be invented According to Dr Zwicky, this is not only a method of straightening out the great new and varied range of chemical combustion engines but is also a way to organize whole field of invention from new power plants employing atomic energy to radio-electronic devices and cancer research

MATERIALS FOR JET ENGINES

The development of jet engines has also brought to light a very important phase in physical chemistry, and metallurgy, *viz* the production of materials for use in turbines which are subjected to heavy pressures at high temperatures In one of the ten lectures delivered before the Institution of Mechanical Engineers, London, a most comprehensive account of the fundamental work done in Great Britain on the development of materials for gas turbines was given by Dr Taylor Prior to 1939 the ferrous alloys used for turbine blades withstood a temperature upto 550°C only, without excessive creep With the steady development of gas turbines, the turbine blade temperatures have risen to 700°C, for which precision casting methods have been evolved which it is believed will also be further outstripped by the use of new alloys with resort to powder metallurgy methods Ceramic blades, though only in their experimental stage of production at present, offer the turbine designer a useful material for use of fixed blades for temperatures above 700°C For turbine discs also, newer alloys have to be used with newer modes of fabrication such as "Warm Working" Materials used for turbine nozzle assembly, combustion chambers, and compressors, have also been the subject of detailed study as regards creep, fatigue, and damping-capacity and a critical scrutiny by fluorescent, chalk and oil, anodizing and supersonic wave methods

CONCLUSION

In the past three years jet propulsion has exerted a profound influence on new aircraft design At constant thrust both H P output and miles travelled per unit of fuel consumed, increased in almost direct ratio to the aircraft speed Consequently the parasitic component of drag should be reduced by every practical design expedient Much research and design work still remains to be done to determine the optimum power plant location within the air plane to obtain the best ram efficiency, to minimize tail pipe losses and to achieve minimum external drag within the large variations of flow through the internal flow system Large airflows carried through the turbojet plants may prove advantageous in the utilization of boundary layer for high lift or lower-

ing the cruising specific fuel consumption Cabin supercharging will be somewhat less troublesome a problem than with other types of power plants, since the required amount of air may be taken from the compressor where it is easily available after compression The high powers available in small packages with turbojet engines permit the airplanes to fly in the sonic range In such cases compressibility effects or the Mach spectrum is the essential factor determining the maximum velocity In fact for the first time in the history of aeronautics developments in power plant have completely outclassed problems in aerodynamics, so that today the aircraft designer, as never before, is frantically trying to catch up with the engine designer, who is miles ahead of him The various problems now remaining to be solved will serve as a challenge to aeronautical engineers for many years

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ERADICATION OF WATER-HYACINTH BY METHOXONE ON A FIELD SCALE TRIAL

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THE popular and easy way of removing the weeds from fields have been to plough and replough the soil and thus remove them by mechanical means With the gradual development and uses of chemicals in relation to cultivation and plant growth, such substances are being increasingly used as poisons for killing the weeds.

In recent years (1942-44) substances have been found which are specifically poisonous to certain kinds of weeds without harming the cereal crops growing along with them in the field One of these compounds 2-methyl-4 chlorophenoxy-acetic acid has been developed as a commercial weed killer under the name 'methoxone'

Kar[1] has tested by preliminary pot culture experiments the efficacy of methoxone as an eradicator of water-hyacinth The present note contains further account of the experiments both in pot culture as well as under actual field conditions carried out by the writer at Dacca, now in Eastern Pakistan

Full grown water-hyacinth plants (*Eichhornia crassipes* Solms) were brought out from some tank and were allowed to grow in large earthenware tubs having 19" diameters each and containing 4 plants

After the plants were thoroughly established in the tubs, different treatments were administered as follows

Treatments	Strength	No of applications
A	Control	
B	1 18 gm 1% dust	1
C	1 18 gm " "	2
D	2 36 gm " "	1
E	2 36 gm " "	2
F	4 25 c c (1 48) 10% solution	1
G	4 25 c c (1 48) " "	2
H	8 5 c c (1 96) " "	1
I	8 5 c c (1 96) " "	2
J	4 25 c c (1 24) " "	1
K	4 25 c c (1 24) " "	2
L	8 5 c c (1 48) " "	1
M	8 5 c c (1 48) " "	2

The methoxone dust was sprayed uniformly on the upper vegetative parts of each water-hyacinth plant by means of a duster The parts of the plants which remained submerged naturally did not come into contact with the sprayed dust In the case of the solution, the methoxone was sprayed by means of a sprayer on the upper vegetative portions of the plants.

Observations were recorded after 12 hours on the first day and then daily *i e*, after every 24 hours to see the effects The dusting and spraying were done on 17-6-47 and the second application was done on 7-7-47 (after 3 weeks)

After 12 hours	The leaves which were erect, showed drooping, *i e*, the distal end of the petiole showed fine curvature
,, 36 ,,	The petiole with the lamina bent down and after touching the surface of the water gradually became flaccid
,, 60 ,,	The lamina and part of the petiole became brownish in colour and shrivelled up
,, 84 ,,	Same as before but more dried up
,, 108 ,,	The roothairs and some rootlets became disorganized and got separated out from the parent plants Parts of the leaves and stems also began disorganizing
,, 132 ,,	Do Do But more pronounced
After 156 hours	Some portions of the stems at the nodal region got disorganized
,, 180 ,,	Do Do Rapid disorganization of the root-stock was also observed
,, 204 ,,	Rapid disorganization of the vegetative parts Disorganization prominent both in roots and leaves
,, 228 ,,	Same as above
,, 252 ,,	Do Do
,, 276 ,,	Do Do
,, 300 ,,	Do Do
,, 324 ,,	Do Do
,, 348 ,, / ,, 372 ,,	Treatment D *i e*, the application of 2 36 gm 1% dust gave very marked result The plants were almost fully disorganized Similarly the treatment K *i e*, 4 25 c c (1 24) 10% solution spray applied twice gave the best result The plants became totally disorganized The aquatic insects, tadpoles and small fishes were however not affected

Microscopic preparations of the tissues of the treated plants were studied and it was found that plasmolysis of the cells of the stems and roots started after 12 hours Greater plasmolysis was associated with the higher doses of methoxone The control plants showed full turgid cells As the tissues became more and more flaccid, plasmolysis was also more prominent

The experiment was further done on field scale on statistical basis in a large tank having a dimension of 259′ × 176′ within the Farm The tank had an inlet as well as an outlet so that the depth of water was maintained at 4′ throughout the course of the experiment There was also a gradual flow of water

52 plots were made out for 13 treatments having 4 replications each Each plot had a dimension of 18′ × 8′ and the distance between plots were 10′ Each plot was laid out on the surface of the water of the pond by posting bamboo poles and surrounding the area with thin bamboos

Full grown water-hyacinth plants were brought from some tank outside the Farm These plants were allowed to grow for a month before the spraying was done 700 plants were allowed to grow in each plot Different doses of both powder and solu-

tion containing methoxone were prepared with the following concentrations for the treatments

Treatments	*Strength*	*No of applications*
A	Control	
B	3 oz 1% dust	1
C	3 oz ,,	2
D	6 oz ,,	1
E	6 oz ,,	2
F	1 75 fl dm 10% sol in 10 5 fl oz of water	1
G	1 75 fl dm 10% sol in 10 5 fl oz of water	2
H	1 75 fl dm 10% sol in 21 0 fl oz of water	1
I	1 75 fl dm 10% sol in 21 0 fl oz of water	2
J	3 5 fl dm 10% sol in 10 5 fl oz of water	1
K	3 5 fl dm 10% sol in 10 5 fl oz of water	2
L	3 5 fl dm 10% sol in 21 0 fl oz of water	1
M	3 5 fl dm 10% sol in 21 0 fl oz of water	2

The methoxone dust was sprayed uniformly by means of a duster on the upper vegetative parts of the water-hyacinth plants The vegetative parts which remained submerged did not come in contact with the sprayed dust In the case of solution the methoxone was sprayed by means of a sprayer Observations were made daily and the effect of the treatments were noted The number of dead plants were recorded after these had undergone complete disintegration of the tissues and by counting the total number of uninjured and injured plants and subtracting the number from the total number of plants in each plot before starting the treatment

The plots which received treatment K i e, 3 5 fl dm 10% solution in 10 5 fl oz. of water and applied twice (i e, 1 12 lbs methoxone in 20 gallons of water and applied twice per acre) showed marked effect by the epinasty and later shrivelling up of the plants. Plots receiving treatment M i.e, 3 5 fl dm 10% solution in 21 0 fl. oz. of water and applied twice (1·12 lbs. methoxone in 40 gallons of water applied twice per acre) also showed the effects but less marked than the previous treatment Plots having treatment E i e, 6 oz 1% dust applied twice (1 12 lbs methoxone in 112 lbs of dust applied twice per acre) also had good effects but the degree of the efficiency of the treatment may be considered less efficacious than the previous two treatments

After 7 days from the time of the first application of the treatment, the affected plants showed shrivelling up and disorganization of the parts The effect became more and more conspicuous with the advance of time and within a fortnight most of the plants became disintegrated and dissolved with the water Those injured and uninjured plants remaining got a second application of the treatment after 3 weeks from the first application After 7 days from the second application of the treatments almost all the plants got disorganised, rotted in water and gradually dissolved

As the treatments K, M and E showed very effective results, the number of injured and uninjured plants of only these plots receiving these treatments were counted after the 4th week and showed the result as noted in the table below

The observations thus recorded indicate that K treatment i e, 1 12 lbs of methoxone in 20 gallons of water and applied twice per acre resulted in the highest number of deaths of plants and the average percentage of dead plants was 90 5 Further the liquid methoxone spray proved to be better than the methoxone dust

The writer is engaged further on this line of work to find suitable time of application, economics of the problem etc *

Type of plants	Treatment K				Treatment M				Treatment E				Average dead plants
	1	2	3	4	1	2	3	4	1	2	3	4	
Dead plants	634	649	667	583	534	536	532	518	327	248	276	224	K 633
Injured plants	45	32	27	68	82	91	75	94	213	240	245	278	M 530
Uninjured plants	21	19	6	49	84	73	93	88	160	212	179	198	E 269
Percentage of death	90 5	92 7	95 2	83 2	76 2	76 5	76 0	74 0	46 7	35 4	39 4	32 0	S E 16 6

REFERENCE

[1] Kar, B K, SCIENCE AND CULTURE, *12*, 545, 1947

* Thanks are due to Sree Eric A R Banerjee, Economic Botanist, West Bengal, for kindly going through the manuscript and for valuable suggestions, to Khan Bahadur Dr S Hedayetullah, First Economic Botanist of the then Government of Bengal who undertook the work and gave me facilities at the suggestion of Messrs Imperial Chemical Industries (India) Ltd, Calcutta and to the latter for supplying us free of cost both 1% dust and 10% liquid concentrate of methoxone for the experiment, to Sree Amal Chandra Bose, Entomological Assistant, for helping me in the spray, and to Sree D D Bose, Statistical Officer and Sree P. R Roy, Statistician, for statistical help.

OBITUARY :

ALEXANDRE GUILLIERMOND (1876—1945)

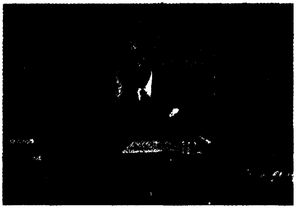
AS the World War II came to an end and communications with countries became normal, we began to know more of what may be called indirect victims of the war, Marie-Antoine-*Alexandre Guilliermond,* Professor at the Faculty of Sciences of Paris and Director of the Laboratory of Plant Cytology, Ecole pratique des Hautes Etudes, Paris, whose name is known to cytologists, botanists, zoologists and medical men, succumbed on April, 1945, at the age of sixty-nine, to the various ailments that assailed him in the last years of his life of isolation as a *refugee* in a suburb of Lyons Some of us in this country who came in contact with him in various capacities wish to pay our tribute to his memory

Guilliermond was born on the 19th August 1876 in the industrial city of Lyons in France He descended from an academic and scientific family on both sides His father, Jacques Guilliermond, an M D and Doctor of Pharmacy, was the son and grandson of pharmacists who were celebrated for their specialities and especially for their scientific works connected with cinchona, opium and diverse preparations of hemlock (*Conium masculatum* L) and iodo-tannic compounds His mother, Magdelaine Rollet, was the daughter of the great French Professor, Dr Rollet, Professor at the Faculty of Medicine of Lyons, where his uncle Dr Etienne Rollet, was also a professor

It was very unfortunate that the father, Dr Jacques Guilliermond, died when Alexandre Guilliermond was not even two years old This, perhaps, accounts to some extent for the rather frail constitution and delicate nervous temperament which persisted almost throughout the life of Alexandre Guilliermond When he was 5 years old, his mother got remarried, and he was brought up by his step-father, Dr Lacassagne, who was a professor at the Faculty of Medicine at Lyons

From this second marriage of his mother were born three children a daughter who later married Dr A Policard, professor at the Faculty of Medicine at Lyons , a son, Antoine Lacassagne, professor of radiobiology at the College de France , and a second son, J Lacassagne, a very successful medical practitioner at Lyons

Alexandre Guilliermond, as a child, was delicate and over-sensitive and nervous, but somewhat of a thinker, almost a dreamer, a look which could be traced in his eyes even in later years, and very independent and gifted for drawing He did not like much his studies at school, but was very curious to know things far above his age, and favoured by the scientific and artistic surroundings in which he lived, was far and away a precocious child although lagging at the same time in his school studies which he began as late as at nine years It was only at the stage of *Baccalauréat* did he develop a real liking for his studies and showed himself an excellent pupil Already his essays of this period on philosophy and natural science were found remarkable for their precision, method and depth Under well-known teachers such as Le Dantec, Caullery, Sauvageau, Grignard (Nobel laureate), he became *Bachelier ès-Lettres* in 1895, took P C N in 1896, and *Licence ès-Sciences naturelles* in 1899 The teaching of Sauvageau fired his imagination and actually decided the first orientation of his penetrating mind Still at Lyons, in 1902,



ALEXANDRE GUILLIERMOND

he received his *Docteur ès-Sciences naturelles* (State doctorate) from the Paris centre It must be mentioned in this connection that he had had the great merit of working on his own, left to himself, almost without a guide, except advice and a few hints received by correspondence from Professors Matruchot, Regaud, and Gaston Bonnier of Paris Matruchot encouraged him to take up mycological studies , Rigaud, later, put him on the way to cytology , and Gaston Bonnier helped him in various ways in his career which was to become so fruitful to botany, and to cytology in particular

Guilliermond was attracted quite early by the monumental studies on yeast of Louis Pasteur and later of Hansen, and was puzzled by the curious inherent fermentative properties of the cytoplasm in the yeast cell It was for his original contributions to the cytology, structure and sporulation of yeasts that he was awarded his doctorate in natural sciences. After

his D Sc , he successively studied the nucleus, nuclear division, germination, parthenogenesis, rise and fall of sexuality and origin of yeasts, culminating in 1910 in the different publications that appeared on the subject, and his own classical monograph "Les Levures" This work* is perhaps better known to the English-speaking world through its revised edition, published in 1920 by Prof F W Tanner, in collaboration with the author

There are few cell constituents which Guilliermond did not illumine by contributing something new and something fundamental to them, right from the early stages of his career Cytologists have differed widely on the presence of a "Central body" in *Cyanophyceae,* although in such cases much of the difference is due to the different methods of fixation Guilliermond reported in *Cyanophyceae* the absence of a "Central body", and varying degrees of concentration of the chromatic material forming a reticulate mass which divides by a process resembling amitosis He studied the achromatic figure, which in plants occurs in two general types amphiastral in *Ascomycetes* and anastral His work on the cytology and sexuality of the *Ascomycetes* is well-known Up to the end of his life he remained a strong supporter of the theory of single nuclear fusion and reduction in the *Ascomycetes* In bacteria, he reported the presence of "Nuclear granules" and "Spiral filament nuclei", in several cases

The mitochondria were brought into prominence in the cytological world in no mean measure by Guilliermond's work He was the first to announce that mitochondria were permanent cytoplasmic inclusions In fact, so many papers were published from his laboratory on the origin, behaviour and biological significance of mitochondria, that they easily form the major part of the literature on the subject He criticized the bacterial theory of mitochondria and strongly believed that they arise only from pre-existing mitochondria by division, persist in the gametes and through the embryonic stages and during the development, perform a variety of functions Plant cells usually contain, besides the nuclear body, three main cytoplasmic elements the chondriome comparable to that of animal cells, lipoids and vacuolar apparatus The first comprises chondriosomes of two kinds one kind develops into plastids, leucoplasts and chromoplasts of various types, and the other kind, relatively inactive, elaborate lipoids and other products as cells differentiate The controversy between Guilliermond and the Dangeards on the role and nomenclature of mitochondria is well known It should be said, however, to the glory of Guilliermond, that in recent years there have appeared many descriptions of the development of plastids from minute primordia in cytoplasm, and these plastid primordia are often claimed to be mitochondria The number of mitochondria rapidly decreases with the formation of plastids

The numerous contributions from his laboratories show his life's lasting interest in mitochondria and the vacuome So much did he appear in favour of vital stains that he gave at times the impression of a Neutral Red or Janus Green cytologist In a lighter vein he would sometimes show his cytological tricks with these stains and vacuoles and mitochondria and chromosomes These moments with him were supremely instructive and unforgettable He believed in the autonomous nature of the vacuome and once considered the vacuolar canalculi and their evolution as homologous with the Golgi apparatus of animal cells Later in his life he confirmed that the Golgi apparatus does not exist in plant cells A translation from the unpublished French manuscript of Guilliermond's book entitled 'The Cytoplasm of the Plant Cell" appeared in 1941 being the Vol 6 of 'A New Series of Plant Science Books' edited by Dr Verdoorn (Chronica Botanica)

As it sometimes happens in a country where competition for academic posts is keen, Guilliermond secured his first post of an extra Lecturer in Agricultural Botany in the University of Lyons only at the age of 37, in 1913 In 1923 he was shifted to Paris as "Maitre de Conférences de Botanique" at the Paris University , he was made "Professeur Sans Chaire" in 1927 and four years later advanced to full professorship at Sorbonne and in 1932 to Directorship of the "Laboratoire de Cytologie végétale de l'Ecole pratique des Hautes Etudes" in Paris He was the recipient of Prix Damazière (1904), Prix Montague (1909) of the Institute de France and Prix Lassère (1931) of the Ministry He was made "Chevalier de la Légion d' Honneur" in 1932, was elected to the Academy of Sciences, Paris, in 1935, and received a *Doctorat Honoris causa* of the Lausanne University in 1937 He was President of the Mycological Society of France, of the Botanical Society of France and Foreign Member of Academies and Learned Societies in the U S A , U S S R , Poland, Czechoslovakia, Roumania and Switzerland

As a Professor, he was most generous in his views of the work of younger men Usually, he did not accept young workers to his laboratory without a crucial test which he carried in his own way, but once they passed the test they enjoyed his full confidence and friendship He will be remembered with deep gratitude and affection by a number of his disciples in different countries for his kind and untiring help and encouragement His school of cytological thought is actively followed in this country by two

* *The Yeasts* by Alexandre Guilliermond. Translated and thoroughly revised by F W Tanner, New York, John Wiley and Sons, Inc

of his former pupils now holding important positions in the Universities of Allahabad and Calcutta His work on yeasts is the basis of a whole section of scientific activity in the Indian Institute of Science, Bangalore, and work along similar lines will be continued at the special Institute of Fermentation Technology which will be started in this country in near future

He married in 1927 his own student (*née* Hélène Popovici), daughter of Prof Popovici, Professor of Botany at the University of Jassey (Roumania) and is survived by his widow and two daughters

We are grateful for the access to many of the details given above to the kindness of Mrs H Guilliermond

Shri Ranjan
R K Saksena
G T Kalé

Notes and News

THE ELEMENTS 43 AND 61

VISIBLE samples of two chemical elements which have been produced at last in the atomic pile were exhibited for the first time at the symposium of the American Chemical Society at Syracuse, New York The element 61 was shown in the form of two salts, the nitrate and the chloride,—two to three mgm of solid appearing as pink and yellow smears respectively on white porcelain discs The element 43 was shown as a silvery metal and as a white oxide

More than twenty years ago, chemists in the U S A and in Italy claimed to have discovered element 61 in ores and proposed the names of illinium and florentium At the moment, Marinsky and Glendenin of Massachusetts Institute of Technology claim to have produced the element 61 in the atomic pile in two ways, by purification of the products of uranium fission and by bombardment with neutrons of a little known element called neodymium The element 61 was isolated in a pure form by ion exchange Marinsky and Glendenin suggest the name 'prometheum' for it

The first positive proof of the existence of the chemical element 43, has been obtained through the atomic research by Parker, Reed and Ruch, who proposed the name 'technetium' for it Since 1846, numerous claims to have discovered the element 43 have been made, in 1925, Noddack and Tacke reported the finding of both elements 43 (masurium) and 75 (rhenium) which they said would be found together in nature Since their announcement, rhenium had become an object of considerable commercial importance The claim, however, in respect of masurium were not confirmed by production of weighable amounts.

Segre and co-workers (1930) attempted to isolate and characterise the element 43, and recognised some radioactive isotopes of the element 43 by bombarding the element 42 (molybdenum) with neutrons in the cyclotron They also noted some of the chemical properties of the element 43 and proposed to call it, technetium Two methods were available for its production, the first was the neutron bombardment of molybdenum, and the second chemical isolation of the new substance from the fission products of uranium Boyd and co-workers (1946) succeeded in isolating technetium by the first method in small amount, sufficient to study several of its physical and chemical properties Near about the same time Parker *et al* isolated several milligrams of it by the second method Moreover, they had been able to produce samples with a chemical purity of 99 per cent They had estimated the β-energy and half-life, and investigated the absorption of visible light (*The Chemical Age, 59*, 110, 1942)

INDUSTRY AND UNIVERSITY RESEARCH

PROGRESSIVE industrialists in America recognise the potent value of the research facilities and the scientific personnel available in universities and technological institutions in the development of industry Since 1929, when there were 95 research scholarships and fellowships supported by 56 companies, there has been a steady growth in industrial support of the university research In 1944, 201 companies awarded a total of 956 fellowships, scholarships and grants for research, and in 1946, 302 companies reported to the National Research Council, U S A, that they were supporting research outside their own laboratories by 1,800 fellowships,

scholarships and grants Of late 300 educational institutions are offering research services to industry Obviously encouraged by financial success of certain of these organisations, more than 70 colleges, universities, and technological institutions have set up such agencies for serving industries

A manufacturing concern gives financial assistance to university research for a number of reasons Some of them are admittedly from selfish interest but more often from a desire to strengthen the educational institutions as sources of trained man power The industrial support of university research is of two types, distinguished by the aim of the research and the limitations and restrictions placed upon the investigators themselves and on the use of results

(*i*) Unrestricted gifts, grants-in-aid and graduate research fellowships given without expectation of any return to the sponsors but rather as contributions toward the general educational programme of the universities

(*ii*) The financing of specific projects of immediate interest and benefit to the sponsors, through industrial fellowships and research contracts with limitations on the fields of study and restrictions on the control and use of the results of research

A support of the first type is usually given in recognition of the need for aiding the universities in their primary function of training men and advancing knowledge Many firms consider it an obligation on the part of industry to assist the universities in carrying on both their training and other research programme At the 52nd Congress of the American Industry, Robert E Wilson, Chairman of the Board of Standard Oil Co said, "Industry must recognise an increasing responsibility to support basic research in our universities The need for more fundamental research and the desirability of fostering such research in the colleges and universities were well stated in a discussion of the future of industrial research The university staffs are generally able to bring a much broader vision to bear on these fundamental problems Where fundamental problems are being prosecuted in industrial laboratories they have a habit of being set to one side and forgotten when more urgent work develops Universities do not maintain the industrial tempo, nor are their staffs in the habit of, nor should they be asked to, work in the confidential capacity required for successful patent control" (*Chemical and Engineering News*, *26*, 2042, 1948)

WIDER USE OF RADIOISOTOPES

A SCHEME has been drawn up by the U S Atomic Energy Commission which will facilitate the production and distribution of certain chemicals containing radioactive elements, for the purposes of research and medical and industrial use For the past two years research workers have been able to get radioisotopes from the Oak Ridge National Laboratory, Tennessee, but if they wished to use the materials in other than their original form they have had to synthesise or manufacture the compounds in small lots in their own laboratories This proved to be an inconvenient and expensive method

In future, commercial firms will be encouraged to manufacture and sell specially selected compounds, each being labelled as such, and the radioactive materials will be supplied by the A E C Certain other compounds, for which commercial production facilities do not exist, will be produced in the commission's laboratories for general distribution The price to be charged for 'isotope-labelled' compounds, produced by commercial firms, will be fixed by firms themselves At present, radioisotopes are sold through a special division of the A E C at a price set to cover the costs of final fabrication The saving which could be effected by volume production is illustrated by the cost to a primary user of one millicurie of ethyl iodide containing carbon 14 The synthesis of a ten-millicurie lot could be done at little more than the cost of one millicurie

One U S commercial laboratory, Tracerlab, Inc , has set up in Boston an organisation equipped to provide a great variety of these radiochemicals for industry and is already supplying to the permitted users, hospitals, universities and research groups, etc , compounds of radioactive carbon 14 However, as the production of radioisotopes increases the restriction will end, and several other undertakings are now being set up with special equipment to process "stock" radiochemicals to special requirements (*The Chemical Age*, July 31, 1948)

INDIAN MICA

THE export of Mica blocks, films and splittings from India, the largest producer of this commodity in the world, to Europe and America, is threatened by recent developments of mica substitutes developed in Switzerland and U S A

According to Dr Lal C Verman, Director, Indian Standards Institution, who recently returned from a visit to Europe and U S A , manufacturers of electrical machinery are now making use of silicone-bonded glass cloth in the place of mica in some of their products More important still is the fabrication by a Swiss technologist of "Mica Powder Film", a composition made from cheap mica-powder A factory is reported to be planned for producing "Mica Powder Film" on a large scale When commercially available, this mica-substitute, it is said,

can successfully compete with natural mica in the manufacture of electrical tape

Another serious development is that of synthetic mica, which is being experimented by U S Army and Navy The process which requires only cheap raw materials has reached the stage of pilot plant experimentation If successful this process will be capable of producing mica crystals of sufficiently large dimensions to compete with the natural product

American users of mica have complained that they are being forced to look for substitutes for mica largely because of the uncertainty of quality and the lack of uniformity of supplies of the mica imported from India Manufacturers of electrical goods feel that export from India of mica of acceptable standards of quality and sizes would help to maintain the present large and persistent demand for this valuable mineral

The average annual export of mica from India is 11,250 tons valued at Rs 217 lakhs, most of which represents hard currency (U S dollars)

The International Organisation for Standardisation (ISO) has entrusted the Indian Standards Institution with the secretariat of an International Committee to develop internationally agreed standards on mica This was accepted by the Committee on Mica Standards of the Indian Standards Institution that met at Calcutta in early September last under the Chairmanship of Mr Chandmull Rajgarhia The Committee further drafted the scope of work for international standardization, which provides among other things for evolving an agreed set of Standard Samples of mica, which could be supplied to all users in India and abroad Mr V P Sondhi, Deputy Director, Geological Survey of India has been assigned the task of procuring full information regarding standard samples, from all countries producing or consuming mica

The Mica Advisory Board of the Government of India have since then recommended that no licences for the import of mica from Brazil or any other country should be issued The Board further recommended investigation of the possibility of setting up a Mica Marketing Central Board The Government of India have accepted these recommendations

It may be recalled that the Mica Enquiry Committee of the Government of India in 1946 reported *inter alia* on the establishment of an Indian Central Mica Committee and put stress on researches in mica (See SCIENCE AND CULTURE, *12*, 88, 1946) But we are not as yet aware of the steps the Government of India proposes to take on these recommendations Unless this is done early, the fate of Bihar mica may be similar to the fate of indigo in Bihar

PROBLEMS OF THE MINERAL INDUSTRIES OF INDIA

THE twenty fourth Annual General Meeting of the Geological, Mining and Metallurgical Society of India was held on September 10 last in the Rotary Hall, Great Eastern Hotel, Calcutta Dr S K Roy President of the Society presided and His Excellency Dr K N Katju, Governor of West Bengal was the Chief Guest on the occasion

In his presidential address, Dr Roy made a survey of the problems confronting India relating to coal and coal reserves, petroleum, Zinc-Lead-Silver ore deposits, Diamond, Gold, Sulphur, Salt and Mica deposits and mineral industry education and research He referred to India's glorious past when our people built the marvellous temples of Madura and Kanarak, cast the giant pillar of rustless steel of Delhi, drove absolutely vertical shafts 600 feet deep in the very hard rocks of Haity to mine gold, and dug immense quarries sometimes 1500 feet long by 250 feet wide and 250 feet deep in the hard quartz rocks of Jawar, (Mewar) to mine Silver, Lead and Zinc Unfortunately, during the last two hundred years of British rule India's mineral industries have not progressed to the advantage of India's national interests Speaking on the coal problems Dr Roy said that the Raniganj and Jharia coalfields have been geologically surveyed at least three times yet the last word on the geological aspects of these coal fields have not been said There are coal seams that have not yet been mapped

Continuing Dr Roy stated that there exists good possibility of finding petroleum in the Indo-Gangetic plain and he urged the geologists with the aid of geophysicists to explore the oil resources of the country He suggested to the Government for appointing a qualified petroleum geologist and control of oil fields in India by 'Supervisors' like those in U S A 'There is no reason' he said 'why the oil companies should not place all their data at the disposal of the Government'

According to Dr Roy, there are still many millions of tons of lead and zinc ore containing silver available in Jawar, Rajputana as well as other economic minerals like diamond, gold etc Concluding he stressed the need of an absolutely first class laboratory where all minerals and rocks could be accurately analyzed In this laboratory mining and metallurgical problems should be investigated and solved and all market reports of metals and minerals, including their market specifications and prices as well as freight to different markets should be available free of cost or at a nominal cost In U S A a sample of gold quartz can be assayed for a Dollar which is equal to Rs 3/3/- ; for the same work the Government rate at Alipur Test House and in the

Indian School of Mines where alone fairly reliable analysis is possible, the rate is Rs 72/-

Addressing the meeting, Dr Katju said as the Minister of Industries in the U P for several years between 1937 and 1947, he was very much exercised about the industrial development and read a great deal of literature about the Geological Survey of India He was then mainly concerned with the natural resources of the U P and it struck him then that the surveys made were rather superficial and certainly not very deep and much work remained to be done

Referring to the usefulness of the generation of power in India, His Excellency said "In modern days in electric energy lies the secret of all success and we shall have millions of kilowatts of these energy throughout the country when the river valleys projects are completed "

"The coming years may well be called the era of great river valleys projects Construction on the Mahanadi project at Hirakud near Sambalpur is in progress The preliminaries connected with the Damodar Valley project have been finalized and I am hoping that the coming winter will see the commencement in right earnest of construction of the first dam Then you have the great Godavari project and many others of similar description "

Speaking on the subject of nationalization of key industries Dr Katju opined "With this question you, as geologist, are not directly concerned Your function is to give us the clue to our big deposits By what agency and under whose control this wealth is to be won that is a different matter Opinion now seems to be fairly unanimous that in the modern context, all key industries must be under national control and so the Government of India have declared"

"I am sure in this vast country all kinds of mineral deposits will be found in one part or another The necessity is for a systematic and extensive survey The Government of India have embarked upon it, though I fear that for want of qualified personnel the progress may not be rapid This deficiency has to be made good " The role of geologists in the new set up of things should be to discover for us our buried treasures and help winning the war against poverty and disease

The following were duly elected officer-bearers of the Society for the year 1948-49 *President*—Dr M S Krishnan, New Delhi , *Honorary Secretaries*—Profs N N Chatterjee, Calcutta and N L Sharma, Dhanbad

TIDE-GAUGE OBSERVATORIES IN INDIA

The desirability of having more permanent tide-gauge observatories in India is emphasised in a note prepared by the President, Survey Research Institute, Survey of India, Dehra Dun At present there are only two such observatories in India, one at Bombay and the other at Kidderpore, which are utilised to test the accuracy of tidal predictions

Geological and archaeological evidence has shown that vertical movements of land and sea have been taking place since times immemorial The exact amount is often a matter of rough guess and the only sure way of arriving at numerical results regarding relative encroachments of land and sea is to establish permanent tide-gauges at several stations all along the coast

The relative change of level between land and sea can be due to movement of either or both Such changes take place in thousands of years Geologists have their own methods of detecting whether a relative change has taken place from such clues as the marks left by the shifting water or by the shape of the coast line, although such detection is not always easy on account of the complexity of the movement Thus there is abundant geological evidence of a former land connection between Malaya and the islands of Sumatra, Java and Borneo The Geologists believe that the intervening land has been submerged due to the rise in sea level during the last 200 centuries Assam and Burma, for example, are still believed to be regions of subsidence It is due to this cause that various large cities in ancient India owe their disappearance Although grave concern for the same reason has been expressed about the stability of Calcutta, tidal observations and precise levelling show that there is no evidence of any general subsidence in the Calcutta region during the last half a century The whole problem however requires further study and detailed planning for the future

Apart from their use of predicting tides the records of permanent tide-gauge observatories can be utilised as follows (1) A number of tidal observatories suitably chosen and fairly well distributed along the coastline of a country enable the mean sea level to be determined reliably from observations extending over a number of years (2) They provide data for deciphering vertical movements of the land and for correlating the variations in the mean sea level in terms of barometric conditions (3) They provide data for study of the deviation of mean sea level at various ports

It is stated that with the vast coastline of India, Pakistan, Burma and Siam covering 6,500 miles from Karachi to Koh Hlak, encompassing as it does unstable regions of considerable interest to geologists and geodesists, to have only 3 observatories at Karachi, Bombay and Kidderpore is thoroughly unsatisfactory There is urgent need for sound planning in India for the starting of permanent tide-gauge observatories all along its coast to provide material for continual and progressive research

WATERWAYS IN THE FOURTH FIVE-YEAR PLAN OF SOVIET RUSSIA

THE basic principles on which the planning of waterways in the Soviet Union during the years 1946-50 is founded may be summarised as follows — (1) Complete exploitation of water resources in the whole basin with a view to creating water power, organising navigation, intensifying agriculture, regulating the run off, providing protection against flood and guaranteeing water supply (2) Concentration of slow descents into single large falls in order to draw the maximum profit from all sources of energy and make water transport more efficient (3) Modernised construction of dams and locks (4) Mechanisation of works (5) Wide-scale introduction of the essential principles of architecture into water engineering

The fourth successive five-year plan in the U S S R embraces a number of important projects for the development of water ways In comparison with the state of navigable waterways in 1940, the plan envisages a general increase of 7500 kilometres in the length of these waterways The five-year programme embraces not only the reconstruction of waterways destroyed in the war, but also the construction of new artificial courses as well as the reorganisation of existing systems which no longer satisfy the growing economic needs of the country Of the larger works the following are already completed (1) Reconstruction of the Swir locks (2) Reconstruction of the Dnieper-Bug system (3) Reconstruction of damaged installations on the northern Don and the White Sea Canal In 1946 the reconstruction of the Lenin lock near the hydro-electric station at Zaporoje was completed The following important new tasks are envisaged (1) Total reconstruction of the canalisation system of the River Moskva (2) The reconstruction and completion of the Manych waterways, which joins the sea of Azov and the Caspian Sea through the intermediary of the Don (3) The first steps in the reconstruction of the Volga—Baltic waterways (the Maryok system)

The five-year plan will also see completed the first stage in the construction of the huge hydro-electric station on the River Kama in the Molotov region, and similar centres will be begun on the River Volga in the Gorki region, on the River Oka in the Kaluga region and on the River Kud in the Boz-dag hills in Azerbeijan (*Water and Water Engineering,* August, 1948)

VACCINE FOR BUBONIC PLAGUE

ANTI bubonic plague vaccine, prepared from living virulent germs which do not produce any plague symptoms when injected into a man, yet produce immunity from attack by the virulent lethal strains of the germ, has been produced at the South African Institute for Medical Research Colonel Culver, the Director of the Institute, said that anti-plague vaccines had in the past been prepared from killed germs Such vaccines, however, had only relatively poor immunizing powers The objection to the new vaccine, prepared from the living virulent germs, is its poor keeping quality (*Chemical and Engineering News, 26,* 2008, 1948)

MEDICAL RESEARCH IN INDIA

THE Annual Report of the Scientific Advisory Board for the year 1947, issued by the Governing Body of the Indian Research Fund Association, reveals that the bulk of the research work has been, in connection with those diseases, such as malaria, cholera, leprosy, malnutrition, plague, etc , which are responsible for high rates of mortality and sickness in India

Malaria —Trials to ascertain the comparative efficacy of various preparations of D D T as indoor residual sprays against adult mosquitoes were carried out by the Malaria Institute of India, Delhi, in seven villages in the Delhi rural area

It has been shown that for indoor residual spraying, a stirrup pump fitted with a suitable nozzle is simpler and better than other types of spraying equipment The work is being continued

Cholera —Field trials in Bengal and Bihar to test the action of sulphaguanidine in the treatment of cholera were conducted under the direction of the Director, School of Tropical Medicine, Calcutta The striking feature observed in the treatment of cholera with this drug was that it acts best during the early stages of the disease

Therapeutic trials in the treatment of cholera with sulphaguanidine, sulphadiazine and phthalylsulphathiazole were also conducted in Calcutta under hospital conditions The results indicate that of these three drugs, sulphaguanidine is the most effective

Leprosy —Three new drugs of the sulphone group, promin, diasone and sulphetrone, were tried out in the treatment of leprosy by the leprosy research workers at the School of Tropical Medicine, Calcutta, with very encouraging results Although these drugs have certain limitations, they have proved particularly valuable in the treatment of those cases of leprosy which cannot tolerate injections of hydnocarpus oil

Nutrition —Research work on nutrition is being conducted by the Association in a number of centres all over India Experiments to determine the comparative rate of growth of rats when fed on a diet

containing *ghee*, purified groundnut oil and *vanaspati* respectively were started in 1947 and are being continued at the Nutrition Research Laboratories, Coonoor The Nutrition Museum of the Laboratories continued to attract a large number of visitors

Experiments to determine the nutritive value of soya-bean milk and soya-bean curd have been conducted at the Indian Institute of Science, Bangalore These, as now prepared, are both palatable and nutritious and the experimental feeding trials now under way in Bangalore indicate that soya-bean milk and its products can provide a cheap nutritious substitute for cow's milk

Plague —Field trials to determine the curative value of sulphadiazine and sulphamerazine in the treatment of bubonic plague were conducted under the direction of the Director, Haffkine Institute, Bombay, with good results Sulphamerazine appears to be the drug of choice as it gives the desired concentration in the blood with smaller doses administered at less frequent intervals

The curative value of the new wonder drug streptomycin was tried out in experimental plague infection in animals The results obtained were striking and the use of streptomycin is now being tried out in the treatment of bubonic plague in human cases The results reported are very encouraging

Clinical Research —Experiments designed to produce lathyrism in laboratory animals have been carried out at the Nutrition Research Laboratories, Coonoor, with partial success The real cause of this crippling disease which is associated with excessive consumption of *Khesari Dal* (*Lathyrus Sativa*) is not yet known

Research on certain aspects of infantile hepatic cirrhosis has been conducted at the Indian Institute of Science, Bangalore, and the Sri Krishnarajendra Hospital, Mysore The work done so far suggests that choline chloride supplemented with a pepsin proteolysed extract of the liver and spleen is effective in the treatment of the disease Further clinical trials are in progress

Maternity and Child Welfare —Based on the report of the enquiry on the bearing of premature and immature births on infant mortality in Bombay, a sub-committee has been appointed to draw up a memorandum on the conduct of enquiries into the important health problem of infant mortality

ANNOUNCEMENTS

Dr M S Krishnan, Superintending Geologist, Geological Survey of India, has been appointed Director, Bureau of Mines, New Delhi under the Ministry of Works, Mines and Power, Government of India

Sir Lewis L Fermor, a former Director of the Geological Survey of India and founder-President, National Institute of Sciences of India has been elected *Correspondent Etranger* of the Société Géologique de France

SRI S K BOSE has been admitted to the degree of Doctor of Philosophy in Mathematics of the Lucknow University on his thesis "A New Transform, which is a generalisation of the well-known Laplace Transform" The thesis was adjudicated by a Board of Examiners consisting of Sir E T Whitttaker, F R S , and Prof E C Titchmarsh, F R S

Sri P C Bandyopadhaya, Assistant Secretary, Indian Chemical Society, is appointed first Secretary, UNESCO Science Co-operation Service for S E Asia at Delhi Sri Bandyopadhaya was connected with this journal as Assistant Secretary, Indian Science News Association from 1937-1940 Dr Alexander Wolsky, Professor of Zoology, University of Budapest, is the Principal Scientific Officer of Science Co-operation Service and he came to India in April last (See SCIENCE AND CULTURE, March, 1948, p 385)

The following are elected as office-bearers of the Aeronautical Society of India *President*—Sri N C Ghosh, Director-General of Civil Aviation, *Vice-President*—Dr V N Ghatage, *Honorary Treasurer*—Sri S C Sen and *Honorary Secretary*—Dr P Nilkanthan The Society was inaugurated at Air Transport Licensing Board Hall, New Delhi, on July 31 last with the object of promoting the advancement and diffusion of knowledge of the Aeronautical Sciences and Aircraft Engineering and the elevation of the Aeronautical professions

A half-yearly list of Botanical papers printed in India, Pakistan, Burma, Ceylon Siam, Malaya and Indonesia will be published by the Botanical Society of Bengal in the Society's Bulletin issued in April and October every year Authors are requested to kindly send their reprints to the Honorary Secretary, Botanical Society of Bengal, 35, Ballygunge Circular Road, Calcutta 19, to facilitate this compilation work

We are informed that the Calcutta Chemical Co Ltd , through their managing Agent, Mr B Maitra, has made a donation of Rs 2,500/- to the Indian Association for the Cultivation of Science and has thereby earned the claim of being a Life-member of the Association according to the Regulations of that body We congratulate the authorities of the Calcutta Chemical Co Ltd for this contribution to the cause of Science

BOOK REVIEWS

Dynamics—By S L Green, M Sc (Lond), University Tutorial Press Ltd, Clifton House, Euston Road, N W 1, London Published 1948 Price 10*s* 6*d*

The book provides a course on dynamics of a particle and of a rigid body The author has not discussed the three-dimensional motions altogether probably on the ground that these will form a much higher course meant for the post-graduate The book in its present form will be of good service to students taking Honours in Indian Universities also, besides being useful to students reading for the General Degree in Arts or Science of the University of London, or for a Degree in Engineering The vector methods used by the author is a feature not very often found in other books of similar standard Most of the exercises are taken from London University examinations The worked out examples are exhaustive and will be very useful to those for whom the book is intended The stock of examples is also well chosen We recommend this book for B A & B Sc Hons students of Indian Universities

K M B

The Perennial Philosophy—Aldous Huxley Chatto and Windus, 1944 Price 12*s* 6*d*

Spiritual knowledge in different degrees of attainment has been revealed to the seekers after truth in all climes and countries The essential character of the perception, however, remains just the same everywhere This anthology of the Perennial Philosophy wherein extract from the writings of the seers —not the professional philosophers—in profuse numbers have been threaded into 27 chapters under diverse heads is a helpful testimony of this 'sameness'

The devout contemplatives of India, the sufis of Islam, the Catholic mystics and the Protestants and Quakers have all in their own characteristic ways harped on the same string that savours 'otherworldliness' in us This sustaining factor in life can be argued out but not exactly dispensed with from our lives, persisting in varied garbs in different countries and contexts Huxley's has been an unique service in introducing such an absorbing topic in so simple a manner that holds our interest all through To those interested in this field the book will be a refreshing study

K B

From Volga to Ganga-By Rahula Sankrityana, People's Publishing House, Bombay, 1947 Price Rs 4/8

This is a bold attempt to trace the evolution of Human society through the ages The account is confined to the Indo-Aryans who lived in Central Eurasia, on the bank of the Volga and subsequently migrated to India through Iran and Afghanistan The book opens with a scene dated 6000 B C when mankind used to live in caves Subsequent appearance of gradually nucleated higher orders of living with complexities in human relationships has been traced in the course of nineteen chapters finally ending with an account of India in 1922 A D The author claims to have presented an authentic account of society at each stage basing his conceptions on varied original sources—particularly 'various languages and their comparative philology, records deducible from or based on clay, stone, copper, bronze, iron, unwritten songs, tales, customs, magic rites' The very fact that the book has gone through a second edition testifies to the popularity of the publication To the reviewer however the inferences in some of the chapters claimed to be objective studies have appeared subjective But this is only a matter of opinion and can be overlooked The book is really one of the most fascinating attempts to interpret history and can be commended to the readers

K B

High Vacua, Principles, Practice and Measurement —By Swami Jnanananda, pp 310 D Van Nostrand Company Inc New York Price $5 50 Macmillan & Company Ltd, London £1 10-0 (1947)

As is stated in the Foreward, the book "supplies a real need for collected and organized information on the technique of the production of high vacua" The technique of high vacua have seen rapid developments during the last two decades, though its beginning dates back to more than a century Recently this subject has assumed a great importance (in their application) in the industrial field—such as in the production of penicillin, magnesium, photo-cells, radio valves,—in the dehydration of food products, in the high vacuum distillation and separation of organic substances The developments of cyclotron, electron microscope etc are possible only because of our knowledge of high vacuum But inspite

of the immense and growing importance of this branch of physical science, the books on this subject are far from numerous Apart from the standard works by Dushman, Kaye, Newman, Dunoyer and others, we have to depend for our knowledge on the various information that are published in different journals from time to time In this respect the book has done a great service in collecting these scattered knowledge in a single volume and thereby giving us a very up-to-date information on this subject

This book is divided into six chapters each of which is again subdivided into a number of sections *Chapter I*—It opens with a nice elementary treatment of the kinetic theory of gases so far as it is needed to the understanding of the theory and practice of high vacuum Fundamental laws of gases, transport and free path phenomena, free molecular behaviour of gases etc are discussed in it *Chapter II*—It contains well-illustrated concise description of various vacuum pumps These are very appropriately divided into several groups—*i e* Piston pumps, molecular pumps, and diffusion pumps These are all arranged according to their historical developments The treatment of the diffusion pumps is very illuminating specially as it covers the latest developments in this direction The various modifications that are made from time to time are mentioned The table containing the performances of the various pumps should have been a little more exhaustive The information regarding various kinds of oil for diffusion pumps should profitably be more detailed *Chapter III*—The measurement of high vacuum is as important as its production and this chapter very ably describes the different kinds of gauges that are now used extensively The vacuum measurement by Ionisation guage, Pirani gauge, Radiometer gauges, are covered thoroughly The descriptions are quite adequate and to the point The modifications and improvements to push the upper limit of measuring the vacuum are described and defects and discrepancies arising out of the use of different gauges are pointed out *Chapter IV*—It deals with the vacuum technique The author calls our attention to the requisites and vigorous conditions that must be observed towards attainment of high vacuum The different types of vacuum valves and traps are described and the information is quite up-to-date *Chapter V*—In it there is good section on "Degassing" The different theories of adsorbed and occluded gas are discussed and the methods of their elimination are pointed out *Chapter VI*—The last chapter is on "gettering" attainment of very high vacua by physical-chemical methods

The book is well provided with numerous references which will be very helpful to the students as well as to the workers in the field There are a few printing errors which are of course very likely in the first edition The price of the book appears to be a bit high

S K M

Fibres other than Cotton and Jute—By J K Sircar Miscellaneous Bulletin No 66, The Indian Council of Agricultural Research Pp ii+59 Published by the Manager of Publications, Delhi, 1948 Price annas fourteen or 1*s* 3*d*

At a time when India has been given the freedom to mould her own destiny and when the people thereof are contemplating to become self sufficient by utilising her raw materials, this pamphlet seems to be a helpful guide in exploiting the fibre resources of the country to meet her present needs

The pamphlet mentions the existence of about 300 fibre-plants all over India (undivided) and the possibilities for exploitation of these fibres (other than cotton and jute) have been discussed Fibres under discussion have been classified as Hard fibres, Soft fibres, Textile fibres, Brush fibres, Grass fibres, Minor forest fibres and Floss fibres

Though the general information, mainly from the agricultural point of view, are available in standard books on textile fibres, yet it presents a good collection of information regarding those fibres for ready reference From the technological point of view it is not rich enough An attempt has however, been made to discuss the fibres with special reference to the following points Species available, provinces where grown, area under cultivation, uses, export-import trade, and work done in India The minor fibres such as, mauritius hemp, manila hemp, banana fibre, pineapple fibre, fibres of *Sidasp, Malachra capitata, Calotropis gigantea, Urena lobata* etc , have not been treated in details, perhaps due to lack of more detailed authoritative reports

It is indeed gratifying to note that the authors' experiences extending for three decades are now made available to all who are interested in India's fibre industry

In 1944, the Government of India requested the author to collect and collate all available information on the Indian fibres (other than jute and cotton) with a view to explore the possibilities of their development The memorandum thus indicates the results so far achieved and how this could be put into practice , it further indicates the experimental work that is essential for developing the fibre resources of the country

Now that the Indian Union is deprived of the major percentage of jute and a good percentage of cotton too, it is hoped that the Government of India

would take suitable steps to develop the fibres, having sufficient possibilities

In this connection, the reviewers would draw the attention, to the immediate necessity for the establishment of a *National Fibre Research Institute*, as stressed in this Journal (see SCIENCE AND CULTURE, *13*, 79, September, 1947) and also a *Fibre Development Board* as suggested by S K G (See *Jour Science Club, 2,* 1948)

There is a list of 71 references to works already published on Indian fibres and also 9 appendices indicating acreage and cost of production, export-import trade, etc

S K G
and
A K G

LETTERS TO THE EDITOR

[*The Editors are not responsible for the views expressed in the letters*]

CORRECT NAME OF *HERPESTIS MONNIERIA* H B K

THE widespread tropical weed commonly known as *Herpestis monnieria* H B K , has had a rather complicated history In India it is called *Adha-birni* and sometimes *Bramhi* It is wellknown that *Bramhi* is used in indigenous medicine in India for making nerve-stimulants The identity of *Bramhi* appears to be obscure In the plains of India people prefer to call this plant (*Herpestis monnieria* H B K) as *Bramhi* This claim is partly supported by the fact that as early as 1785, this plant from India was described by Lamarck as *Bramia indica** The generic name *Bramia* was latinised from *Brami* described earlier by Adanson in 1763 But, in the hills of India, *Bramhi* is known by an altogether different plant, *i e* , *Hydrocotyle sibthorpioides* Lam (syn *Hydrocotyle rotundifolia* Roxb) The identity of the true *Bramhi* could only be settled in consultation with a number of *Kavirajas* or *Vaids* from different parts of India

Coming back to the name of *Herpestis monnieria*, it must be noted that there are several earlier names and the correct name will depend on the taxonomical interpretation of the plant as well as on the application of the rules of nomenclature The earliest name of this plant is *Lysimachia monnieri* Linn and *Gratiola monnieri* Linn B Jussieu and P Browne proposed the generic name *Moniera* in 1756 and Michaux described this plant as *Monniera cuneifolia* Michx (changing the spelling from *Moniera* to *Monniera*) A few years earlier Loureiro quite independently described this plant as *Septas repens* Lour , under a newly created genus *Septas* Lour It was soon realized that *Monniera* could easily be confused with an earlier genus of *Rutaceae* called *Monnieria* Linn The case for *Septas* was even worse At the time of its description, the generic name was already in existence for a genus of *Crassulaceae* It was therefore necessary to overcome these difficulties and confusions Some authors therefore preferred to use the later generic name *Herpestis* Gaertn f , to avoid confusion between *Monniera* of *Scrophulariaceae* and *Monnieria* of *Rutaceae*, and Meisner proposed the new name *Heptas* for *Septas* of Loureiro Gamble, in his Flora of Madras 952 (1923) used the name *Moniera*, although this generic name has been rejected in favour of *Bacopa* Aublet (see International Rules of Botanical Nomenclature 107, 1935) So it will be realised that the name of this plant moved from one genus to another for a long time

We are indebted to Pennell for the clarification of this involved nomenclature In 1920, he almost settled the name as belonging to the genus *Bramia* calling this plant as *Bramia monnieri* (Linn) Pennell But in a recent paper published in 1946, Pennell, on a reconsideration of the case changed his own earlier decision I have read Pennell's recent paper with great interest and I am convinced that he is justified in changing his earlier views This was necessary on a natural and phylogenetic consideration of the case, and we have now an "aggregate" under the name *Bacopa* In this, he has repeated a similar decision made earlier by dissolving such genera as *Vandellia, Bonnaya, Illysanthes* to a newly reconstituted genus *Lindernia* Although his decision on *Lindernia* was indeed unique and at first appeared to

* Apparently the name *Bramia indica* signifies that the plant is a native of India For widely distributed pantropical weeds such a view is unfortunately not possible Similarly, *Plumbago zeylanica* Linn should not be regarded (even though the name implies) as a native of Ceylon

be somewhat revolutionary, the conception of the "*Bacopa*-aggregate" was however not new This was the view taken by Wettstein as early as 1891, and Pennell in most parts accepted Wettstein's opinion with some modifications The most significant change in Wettstein's treatment of *Bacopa*, is the exclusion of *Mecardonia* and inclusion of such genera as *Naidothrix* and *Silvinula* Our plant should therefore be called *Bacopa monnieri* (Linn) Pennell The synonymy appears to be as follows

- BACOPA MONNIERI (*Linn*) *Pennell* in *Proc Acad Nat Sc Phila 98*, 94 (1946)
- *Lysimachia monnieri* Linn Cent Pl *2*, 9 (1756)
- *Gratiola monnieri* Linn Syst Nat ed , *10*, 851 (1759)
- *Gratiola monniera* Linn Amoen Acad *4*, 306 (1759)
- *Bramia indica* Lam *Encycl 1* 459 (1785)
- *Septas repens* Lour Fl Cochinch 392 (1790)
- *Monniera cuneifolia* Michaux, Fl Bor Am *2*, 22 (1803) , Gamble Fl Mad 952 (1923)
- *Monniera brownei* Pers syn *2*, 166 (1807)
- *Herpestis monniera* H B K Nov Gen Sp *2*, 366 (1818) , Hook f Fl Br Ind *4*, 272 (1884) , Prain, Beng Pl 765 (1903) , Haines, Bot Bihar Orissa 622 (1922) , Kashyap, Lahore Dist Fl 186 (1936)
- *Herpestes monniera* Kunth, Syn Pl *2*, 125 (1823) , Dalz et Gibs Bomb Fl 178 (1861)
- *Lepidagathis repens* Spreng Syst *2*, 827 (1825)
- *Habershamia cunneifolia* Raf Neogenyton 2 (1825)
- *Heptas repens* (Lour) Meisn Pl Vasc Gen Comm 202 (1840)
- *Anisocalyx limnanthiflorus* Hance ex Walp Ann Bot Syst *3*, 195 (1853)
- *Bacopa monniera* (Linn) Wettst in Engl Pflanzenfam *4*, *3B* 77, (1891)
- *Bramia monniera* Drake, Fl Polyn Franc 142 (1893)
- *Bramia monnieri* (Linn) Pennell in Proc Acad Nat Sc Phila *71*, 243 (1920)

In Hooker's Flora of India 4, 272 (1884) and Prain's Bengal Plants 765 (1903), three more species are recorded under *Herpestis* Correct name of these species are as follows —

- *Herpestis chamaedryoides* H B K =*Mecardinia dianthera (Swartz) Pennell*
- *Herpestis floribunda* R Br =*Bacopa floribunda (R Br) Wettst*
- *Herpestis hamiltoniana* Benth =*Bacopa hamiltoniana (Benth) Wettst*

In the preparation of this note I have received valuable help from Pennell's recent paper It is not pretended therefore to be an original note, but, it is prepared in the hope that it will be found useful to many botanical workers in India

D CHATTERJEE

C/o The Royal Botanic Gardens,
Kew, England, 15 4-1948

POLYESTERIFICATION OF HYDROXY ACIDS PART II 9 10 DIHYDROXY STEARIC ACID

IN the previous part[1] the results of the polyesterification of 12 hydroxy stearic acid have been reported In the present part attention has been paid to 9 10-dihydroxy stearic acid, a hydroxy acid containing two secondary hydroxyl groups at the adjacent positions

From table I it will be evident that with the reaction continuing under isothermal conditions, the variations in acid and ester values were exactly similar to the one with 12-hydroxy stearic acid The activation energy for the reaction was 22 9 K cal, and was comparable with the previous one The uncatalyzed reaction was third order while the catalyzed one followed a second order course The rate of reaction however was much faster as the number of effective collisions greatly increased consequent on the increase in the number of hydroxyl groups

TABLE I

t (hrs)	180°C		200°C		220°C	
	A V	E V %	A V	E V %	A V	E V %
½	149 9	15 1	127 1	28	98 3	44
¾			111 6	37	84 6	52
1	174 4	28 9	97 1	45	66 0	62
1¼			91 6	48		
1½	108 9	38 3	83 7	52	51 7	70
1¾			76 7	56	48 1	72
2			68 9	61		
2½	87 3	51 6				
3	76 5	57 7				

However, there are certain fundamental and characteristic differences between the polyesterification of dihydroxy acid and monohydroxy acid In the case of monohydroxy acid the reaction product was solid all through With dihydroxy acid the product was at first opaque, waxy solid, then it became resinous solid, then soft resinous semiliquid mass and

finally clear, transparent, insoluble and infusible solid The mono acid never became insoluble and infusible, however long they might be heated either alone or with catalyst This fact may be easily understood from the Carothers[2] functionality concept Monohydroxy acid is a bifunctional compound, so the reaction can lead to products with straight chain structure only, which are generally soluble and fusible The dihydroxy acid on the other hand is trifunctional and if both the OH groups enter into reaction they will ultimately lead to three dimensional structures which are insoluble and infusible There are two possibilities by which the three dimensional structure may develop Either the molecule at first may give long chains by esterification and finally cross linkings may be established between the chains through unreacted OH groups by ether formation , or the reaction may be an esterification one all through, giving extensively branched compounds having closely entangled and high molecular structure The insoluble product could be smoothly hydrolyzed to the original dihydroxy acid by alcoholic potash and the yield was 97-98 per cent This at once discards the ether formation hypothesis since the ether linkages are not broken down by alcoholic potash Further, Carothers'[2] functionality concept states that if insolubility be due to ether formation between the chains the reaction should stop at 50 per cent stage measured by acid value method On the contrary the reaction could be carried to 96-97 per cent before the substance became insoluble This is also an additional proof of the validity of our second assumption

My thanks are due to Dr P K Bose, D Sc , F N I , Director, Indian Lac Research Institute, Namkum, Ranchi, for his keen interest in the present work

SADHAN BASU

Indian Lac Research Institute,
Namkum, Ranchi 17-6-1948

[1] Basu, S , SCIENCE AND CULTURE, *14*, 120, 1948
[2] Carothers, *Trans Farad Soc* , *32*, 39-49, 1936

TAPIOCA AS A SOLUTION OF THE FOOD PROBLEM

I HAVE followed with keen interest the notes by Mathews[1] and Mukherjee[2] on Tapioca as a solution of food problem, and have also seen the note of Roy[3] I had been myself investigating, for some time past, on the yield of Cassava roots and outturn of Tapioca food in the Agricultural farm at Subirnagar in Rangpur Dt I am also one of those who think that cultivation of Cassava and manufacture of tapioca food has not been given the consideration and attention it deserves

The cultivation of Cassava is simply described as follows The land should be well ploughed and the soil made soft, as this would increase yield Cuttings of mature Cassava plants—6 inches long with a number of nodes—should then be planted in the soil three or four inches deep horizontally five feet apart The place should be covered by straw etc , and moderately watered every 6/7 days When the plants come out the usual weeding, loosening the earth, earthing up of plants in rows should be done When the plants attain the height of about three feet the terminal buds should be nipped This ensures higher yield Nipping can be done second or third time also with good results Planting can be done any time of the year but planting in March or April seems preferable There are two varieties of Cassava One is bitter and is rather poisonous unless properly treated and the other is sweet This latter variety is common and is the subject for this note It takes about a year for the plant to mature which is its only drawback There are, however, some varieties which mature earlier Results of investigation into the minimum time required for the plant to produce maximum yield will be communicated in a separate note Rats are a great menace to this plant and precaution in this direction have to be taken

Arrowroot, flour and *suji* are manufactured from the Cassava roots by the following process The roots are first washed and then put into water in a big vat and allowed to stay for 6/7 hours After this the thick skin of the tuber is easily peeled off and the karnel is then cut into small pieces and again washed and then made into a pulp in a *dhenki* or some wooden receptacle by hammering by a long thick wooden bar The pulp is then put into a strong cloth and the water squeezed out (just as in a cheese press) The cloth with the pulp is then put in another vat in clear water and the pulp stirred well (inside the cloth submerged in water with the pulp) The water will gradually become milky white When all the starch has thus been removed from the pulp, the pulp is dried and hammered and made into powder and then seived by a fine cloth The finer portion which has been called here flour will come out and the residue in the fine cloth will resemble ordinary *suji* and can be used accordingly Meanwhile the starch in the milky water in the vat will settle The water can be easily decanted and the precipitate at the bottom may then be dried in the sun to obtain what has been described here as arrowroot or tapioca meal This is also known as Brazilian arrowroot

Results of experiment with 54 plants are given below:

No of experiments	No of plates	Weight of tubers Md	Sr	Ch	Weight of food manufactured: Flour Sr	Ch	Suji Sr	Ch	Arrowroot Sr	Ch	TOTAL Md	Sr	Ch
1	4	0	18	10	1	0	1	14	1	8	4	4	6
2	8	0	38	13	1	6	5	8	2	8	0	9	6
3	10	0	19	4	1	2	1	10	0	12	0	3	8
4	8	0	20	4	0	0	3	12	0	10	0	4	6
5	4	0	7	0	0	6	0	10	0	8	0	1	8
6	4	0	7	14	0	3	0	8	0	3	0	0	14
7	4	0	8	8	0	8	0	14	0	4	0	1	8
8	4	0	12	0	1	2	2	8	0	6	0	4	0
9	4	0	15	8	1	14	3	0	0	10	0	5	8
6660	4	0	14	8	3	0	1	12	0	4	0	5	0
Total	54	4	2	5	10	9	22	0	7	9	1	0	2

Thus the average yield of raw root per plant was 3 srs *i e*, say 6 lbs as against only 1 34 lbs obtained by Mathews at Baranagar The low yield at Baranagar might be, besides other reasons, due to the plants not being nipped which is evident from the average height of the plants there *viz*, 10 15′ The average height of plants at Subirnagar was about 5′ only The yield obtained by Mukherjee[4] was even much higher than at Subirnagar He obtained 220 lbs of raw root and 45½ lbs of dry food from 9 plants In case of large number of plants the average yield is expected to be lower Besides, the degree of moisture present in the soil or in the roots is another factor at the time of extraction More stable criterion for yield would be the quantity of finished produce obtained from the roots At Subirnagar as will be seen from the table 1 5 lbs of produce was obtained per plant as against 5 lbs obtained by Mukherjee from 9 plants At Subirnagar there were 2 plants in every 5 ft while there was one in the Sibpur experiment Thus space for space the average yield at Subirnagar may be taken as 3 lbs

Planted five feet apart an acre would hold about 1700 plants and would produce about 100 mds of dry food When done on a large scale the produce may not be as high but in any case it can not be less than 50 mds On an average price of say 4 as per seer an acre would yield about Rs 500/- Besides, there would be about 200 mds of green good fodder and thousands of cuttings which may be used as such or even as fuel Those would bring an additional amount of about Rs 50/- to Rs 80/- per acre

In case of large scale cultivation and manufacture such simple machinery as a turnip slicer, turnip pulper, a cheese press and a small grinding mill may be used.

As a drought resisting plant a heavy yielder and as a nourishing food staff which is easily manufactured Cassava has hardly a parallel

The arrowroot can be used as a diet for the sick in the usual way and the *suji* and flour can be used just as ordinary *Suji* and flour of wheat In case of flour, however, it is better to mix some quantity of wheat flour The Cassava flour can also be used for making *'halua'* and biscuits For the latter ¾th Cassava flour and ¼th wheat flour should better be used Part of the starch may also be used in various industries specially for making glucose and the plants can be turned into a money crop

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21-6-1948

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STUDY ON LATHYRISM, A DISEASE PRODUCED BY *LATHYRUS SATIVUS* LINN

'LATHYRISM', a disease manifesting itself as spastic paralysis of lower limbs, breaks out in epidemic form in some parts of India specially in the Central Province where this has been found to be associated with the consumption of *Lathyrus sativus* in large quantity To make a systematic study of this disease, feeding experiments were, therefore, undertaken on different laboratory animals in search of suitable animal in which the lesions similar to those in man could be produced

It has already been reported[1] that the pigeons fed on *Lathyrus sativus* at 30 per cent level of intake

for seven weeks showed distinct tendency towards development of lathyrism In continuation of the experiment on other animals, it has been observed that the chicks and guinea pigs also develop similar symptoms of lathyrism as retardation of growth, general weakness, reluctance to move about and swelling of the hind legs

Attention was next directed to find out the toxic principle of *Lathyrus sativa* responsible for development of lathyrism For this purpose finely powdered *Lathyrus sativa* was extracted exhaustively with petroleum ether (B P 50-65°C) and an oil containing some yellow pigment was obtained The amount of oil-mixture was 1 22 p c of the dry seeds Various other solvents were also tried for extraction but the amount extracted was very small in each case The oil-mixture extracted with petrol ether was used for feeding experiment after diluting ten times with groundnut oil

Twentyfour guinea pigs weighing between 145 to 165 gms were uniformly divided into four groups and were given the diets as shown below

Name of the foodstuff	Diet A	Diet B	Diet C	Diet D
1 Bengal Gram	50	50	—	—
2 *Lathyrus sativa* whole-powder	—	—	50	—
3 Defatted *Lathyrus sativa* powder	—	—	—	50
4 Wheat	30	30	30	30
5 Malted Barley	10	10	10	10
6 Milk powder	10	10	10	10
7 Groundnut oil	6 1	—	6 1	6 1
8 *Lathyrus sativa* oil diluted with groundnut oil	—	6 1	—	—

Animals of all groups were supplied with adequate amounts of vitamins A and D in the form of cod-liver oil, B-vitamins in the form of yeast tablets and vitamin C as pure ascorbic acid

Animals on Diet A taking Bengal Gram in their food showed excellent growth and general good health

Animals on Diet B containing diluted oil of *Lathyrus sativa* along with Bengal Gram showed retardation of growth, weakness, reluctance to move about and died on the 6th week

Two animals on Diet C showed definite paralysis of hind legs besides general ill health and retardation of growth In case of others retardation of growth, loss of hair and swelling of hind legs were observed All the animals died on the 5th and 6th week

Animals on Diet D also showed slight retardation of growth, loss of hair and reluctance to food-intake They all died after the 8th week

The above experiments show that the oil-mixture of *Lathyrus sativa* extracted with petrol ether is definitely toxic and the extracted residual *Lathyrus sativa* is less harmful than unextracted ones This experiment suggests that the protein moiety of *Lathyrus sativa* is also responsible to some extent Most probably the actual symptoms of lathyrism as reluctance to move about, swelling and paralysis of hind legs are developed by the toxic principle present in the oil-mixture of *Lathyrus sativa* extracted by petrol ether and the other symptoms as retardation of growth, general weakness and loss of hair seem to be manifested by the combined effects of both the protein and oil moieties of *Lathyrus sativa* Basu, Nath, Ghani and Mukherjee[2] have shown that the above pulse is deficient in tryptophane It is not improbable that the amino-acid make-up of the protein of this pulse may have some influence in accelerating the onset of the symptoms of lathyrism by *Lathyrus sativa*

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ON THE CULTIVATION OF IPECACUANHA IN INDIA

Cephaelis Ipecacuanha (Bort) A Rich which yields the commercially important drug "Ipecac" is a native of moist tropical forests of Brazil In its natural habitat it occurs in the thick shade of ancient trees forming a characteristic undergrowth preferring well drained open spots enjoying a steady atmosphere It is essentially a tropical plant and is extremely sensitive to frost

The introduction and acclimatisation of this important drug-yielding plant in India is associated with the names of two illustrious botanists, the late Dr T Anderson and Sir George King, former Superintendents of the Royal Botanic Garden, Calcutta Between the years 1866 and 1885 large scale experiments were carried out in the lower ranges of the Sikkim Himalayas and Nilgiris in South India Attempts were also made to cultivate the plants on the plains of Calcutta and in the Terai region These

experiments were conducted with a view to studying the optimum conditions for the production of the drug and finding out suitable areas for successful cultivation The result of these experiments carried out for nearly 20 years under varied conditions in different parts of India has yielded much valuable scientific data with regard to cultivation It has been ascertained that the plant thrives only under a limited range of physiological conditions It is highly sensitive to temperature, light and shade, requiring a moist hot climate and steady even temperature ranging from 75° to 90°F for healthy development As regards soil, a rich alluvial soil containing leaf mould, lime and magnesia is found best suited for vigorous root development The plant thrives better under the canopy of trees or artificial shade similar to the shade under the over-head canopy of trees in a tropical rain forest From practical experience it has been found that poor cultivation and undoubtedly most of the failures are due to inadequate precautions in providing the plants exact ecological conditions required for growth Forced green house experiments under artificial conditions within the city wall (with records of Calcutta humidity) naturally leads to all sorts of physiological complexities detrimental to the healthy growth of the plant

Mitra and Chakravarti[1] have recorded some observations made during their preliminary experiments on the cultivation of Ipecacuanha under what may be termed forced abnormal laboratory conditions with reference to the humidity factor alone No accurate data of diurnal, nocturnal and seasonal variations in light, temperature and humidity has been recorded in order to study their effect on the growth of the plant They do not also seem to have taken into account the most important factor namely the edaphic factor which might have caused etiolation of the leaves Moreover experiments carried out in a small box with partially parched soil of Mungpoo mixed with leaf mould hardly gives a correct idea about the normal requirement of the plant Being an extremely weak delicate straggling undershrub with sensitive rootlets the plant can hardly withstand transit without considerable changes in its physiological make-up This might have far reaching effect resulting in the production of so-called browning of parts and development of a poor shoot as the photo shows (*loc*, *cit*, p 505) The plant after striking root as a result of watering, might have unfurled some of the leafbuds under moist soil conditions and not due to humidity alone It appears to us that the experiments indicate doubtful results.

It has been previously[2] noted that more than 60,000 plants were being grown successfully from root-cuttings at the Rungbee Cinchona Plantation in Sikkim The senior author of this note has seen it growing luxuriantly in the Government Cinchona Plantation among the virgin rain forests of South Burma during 1929, 1930 and 1931 Reports of promising results have been received from the Government Plantation, Kallar (Madras), Johore and Selangor in Federated Malay States and also from China and Tanganyika Considering the large demand of the drug by the medical profession as a specific for dysentry and the scarcity of supply from foreign countries it is necessary to take up the question of growing the plant in India on an extensive scale in suitable areas A thorough ecological and physiological investigation will have to be undertaken along with the preliminary field survey of this and the allied species in order to ascertain the exact conditions required for successful cultivation A separate paper on the possibilities of Ipecacuanha cultivation in suitable areas in India will be published elsewhere

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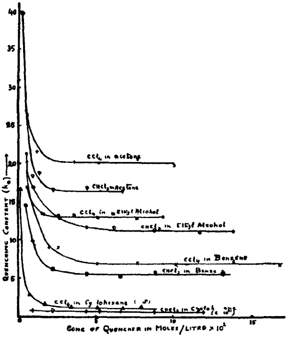
ON THE QUENCHING OF FLUORESCENCE IN SOME NONAQUEOUS SOLVENTS

THE quenching efficiency of an inhibitor of fluorescence can be estimated from the value of k_Q calculated according to Stern and Volmer[1] equation from the percentage quenching of fluorescence (I_0/I) This equation has been derived on the assumption that the percentage quenching is small[2,3] The mechanism of the quenching process has generally been accepted to be a diffusion-controlled bimolecular reaction, where the role of Coulomb forces has long been recognised[4] in the case of ionic quenchers, while those of Van der Waals forces and of forces originating from the interaction of the dipole moments of the reacting (both quenching and fluorescing) molecules have been recently investigated[5,6]

In the present investigation, the quenching effect of a polar ($CHCl_3$) and nonpolar (CCl_4) inhibitor on the fluorescence of anthracene in different nonaqueous solvents, both polar and nonpolar, has been examined in a Lumetron photoelectric fluorescencemeter. Radiation of $\lambda = 3650$ Å was used as

the source of excitation The molecular dimensions of both $CHCl_3$ and CCl_4 being almost equal ($r \sim 1$ 3Å), will influence the diffusion-controlled bimolecular reaction to the same extent and both being non-electrolytes, any difference of behaviour on the part of these inhibitors might be mainly attributed to the difference in the dipole moments of the two and chloroform being polar should be a more efficient quencher of the two The mean values of k_q shown



in the following Table bring forth just the opposite result, CCl_4 showing the more powerful effect This conclusion has also been corroborated in a few cases by direct observation of I_0/I at the same molar concentrations of the two quenchers

Solvent	k_q for CCl_4	k_q for $CHCl_3$
Benzene	7 53	5 77
Cyclohexane	1 65	0 84
Acetone	20 88	17 59
Alcohol (Ethyl)	13 12	11 47

Viscosity changes due to small additions of these quenchers were almost negligible and hence had no influence on the rate of quenching in these cases These results therefore suggest that there must be some other factor besides Van der Waals forces and dipole interactions as hithertofore visualized and this is probably the influencing factor in these cases Bowen's[7] observations of the higher value of k_q with m-bromotoluene (2 14) than with o-bromotoluene (1 44) in quenching the fluorescence of anthracene solution in toluene also lend support to the present observations

The plot of k_q against c, the quencher concentration, as shown in the figure for the different solvents and quenchers mentioned above obviously shows a steep fall of k_q in all cases at lower quencher concentrations The values become almost constant in the regions where the amount of quenching is considerable This is anomalous in the sense that the Stern and Volmer equation should be applicable to cases of small quenching only Assuming the validity of this equation in the case of nonaqueous solutions as well, the initial steep fall of the curves is interesting and is being worked out

My best thanks are due to Prof S N Mukherjee for his keen interest and valuable help in this connection

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2-8-1948

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FORECASTING OF TRACKS OF STORMS IN INDIAN AREA

Forecasting of the tracks of depressions and storms is a problem of considerable importance and difficulty It has been stated that the direction of movement of storms and depressions is generally in the direction of movement of air at cirrus cloud levels How far this criterion is applicable in tropical latitudes requires detailed examination, but an examination of a few storms and depressions by one of the authors showed that little help could be obtained in forecasting tracks of storms from the available data of movement of cirrus clouds and winds at these levels During the last few years, the subject of forecasting of tracks of storms has received wide attention[1] but the results obtained do not appear to be of much practical help in the day to day forecasting

N Sen and his collaborators[2] have stated that it is possible to forecast the movement of storms and depressions from a study of the Directive Field (in the upper air between 4 to 8 Kms, depending on the seasons) even a day or two before the formation, and that the movement is along a stream line in the Directive Field

14 well marked storms and depressions in the Bay of Bengal and the Arabian Sea during the period 1939-1946, were studied with a view to examine how far the above ideas of Sen are applicable The wind data pertaining to several of these storms and depressions were meagre and the deformation field at 8 Kms could not be drawn, and as such the examination had to be based on the field at 4 to 6 Km, the drawing of which was also not free from uncertainty in some of the cases

It was found that the movement of 8 storms could be forecast satisfactorily from the Directive Field at 4 to 6 Kms, approximately in the case of 3, and the result was unsatisfactory in the case of 3 storms

In the attempt to forecast the track a storm would follow, it is assumed that the Directive Field with the axes does not change to any appreciable extent during the course of the storm The large percentage of agreement between the predicted and actual tracks would indicate that the Field does remain fairly constant in most of the cases, particularly in the intensifying stages It would also appear that the more undisturbed the Directive Field remains, the more intense a storm is likely to be and with a longer life The unsatisfactory agreement in the case of three storms can probably be attributed to the changing of the Directive Field and also partly to uncertainty of the Directive field, for want of sufficient data

The results of the study are quite encouraging and further work in this direction is in progress

The details will be published elsewhere

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New Delhi, 9-8-1948

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ORIENTATION OF CELLULOSE AND ITS RELATION TO DECAY CAVITIES IN THE SECONDARY WALLS OF *CHIR* (*PINUS LONGIFOLIA*) TRACHEIDS

IN recent years the orientation of cellulose in the secondary wall of tracheary elements has received wide attention of the wood anatomists [1,2,3,4,6,8] Banerjee[5] carried out similar investigations in India and obtained significant data by X-ray analysis of vegetable fibres It has been demonstrated that the microscopically visible striations, mechanical cracks, pit orifices and the enzymatically produced cavities by some fungi are usually arranged parallel to the long axis of the fibrils of cellulose and therefore of micelles and chain molecules For experimental evidences crystalline aggregates of iodine may be induced to form between these fibrils

A few samples of *chir* wood (*Pinus longifolia*), both sound and infected by *Lenzites striata*, were collected from Dehra Dun and adjoining localities to examine the cellulose arrangement in the tracheids and their relation to later formed decay cavities, which have been found to exhibit similar and other interesting features The behaviour of the fungal hyphae inside the timber also appears to be of some significance in this connection

The method of Bailey and Vestal[3] has been adopted with modifications as deemed necessary for different materials for inducing iodine crystals to form between the fibrils in both infected and sound wood *

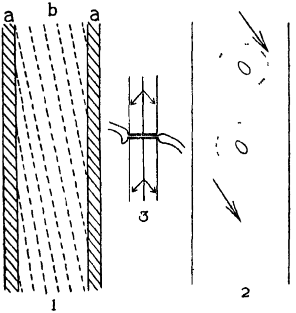
As in all normal coniferous tracheids the secondary wall of *chir* tracheids consist of 3 layers—(1) inner, (2) central and (3) outer (Bailey and Vestal) [3] The standard method induces iodine crystals to form only within the central and outer layers after considerable variation of treatment

In pitted *chir* tracheids the cellulose of both the outer layer and the central layer are ordinarily helically oriented, and that the helixes of the central layer have very steep pitches, whereas those of the outer layer have comparatively low pitches (Fig 1) Some of the *chir* tracheids, usually without pits, exhibit that the helical pitch of the central layer are so steep as to appear parallel to the long axis of the cell This fact has been substantiated by Bailey and Vestal[3] and Bailey and Berkley [4] According to these authors the arrangement of cellulose in the central layer is approximately parallel or in a spiral of about 3° to the long axis of the tracheids, and that this layer is isotropic

* "When sections of lignified tissues are chlorinated, rinsed in 95% ethyl alcohol, treated with dilute ammonia in strong ethyl alcohol, rinsed in alcohol, chlorinated, rinsed in alcohol, stained in a 2%—4% aqueous solution of iodine—potassium iodide, and finally mounted under a cover glass in a drop of 60% sulphuric acid, dark brown crystals of iodine form within the layers of secondary wall"

Frey and Scrath, Gibbs and Spier (Bailey and Vestal)[2] revealed to a considerable extent the complex nature of the arrangement of cellulose in and around the bordered pits In *chir* tracheids, however, the author failed to detect the orientation of cellulose in such specific cases

The axis of pit orifices, and mechanical cracks are all oriented parallel to the helixes of the fibrils (Fig 2) It has also been found that there is no regular alternation of right-handed and left-handed helixes in the secondary wall as observed by many investigators



Bailey and Vestal[3] and Bailey and Berkley[4] established that the enzymes of some wood-rotting fungi dissolve cavities which are oriented either helically or parallel to the long axis of the cell In the central layer of the wall of *chir* tracheids the decay cavities are usually cylindrical and sometimes parallel to the long axis of the cell, but often appearing quite irregular The hyphae penetrating the outer layers are oriented transversely through the helixes with respect to the long axis of the tracheids (Fig 3) It, therefore, appears that there is no constant correlation between the orientation of cellulose and the plane of enzyme action

The hyphae, both thin-walled and thick-walled, are branched, septate, and run longitudinally through the tracheids They produce numerous bore-holes both in the central and outer layers, the thin-walled ones often making easy passage through the pits The thick-walled hyphae are adpressed to the tracheid wall, often forming big T, sending off branches and penetrating the same tracheid at many points, and also show indications to form medallions These hyphae usually show constriction when passing through a cell-wall At late stage the thin-walled hyphae become of very big diameters filling the tracheids and destroy most of the walls in longitudinal direction Microchemical tests in sections from early decayed wood tend to indicate no destruction of lignin As the rot is of brown type, this is expected Positive cellulose test has also been found difficult to demonstrate As indicated, in advanced stages most of the wall matters including the lignin collapse

It has been found that the tracheid walls are always dissolved ahead of the tips of the hyphae and that the bore-holes are always smooth This supports Proctor's[9] enzymatic theory of cell-wall penetration as against Cartwright's[7] mechanical theory

Examination of these and other materials is in progress with the help of X-ray and polarised light

The author desires to thank Sri A K Ghosh, Calcutta, for his helpful suggestions and interest throughout the progress of this investigation

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Calcutta, 30-8-1948

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POLYESTERIFICATION OF HYDROXY ACIDS, PART III 12 10 9 TRIHYDROXY STEARIC ACID

In two previous notes[1] the results of the study of polyesterification reactions have been reported The present part deals with 12 10 9 trihydroxy stearic acid

The nature of the reaction products and the actual kinetics of the reaction are somewhat different from the two previous acids After the esterification is 40 per cent complete the product becomes a free-flowing liquid and practically insoluble in alcohol, though freely soluble in benzene-alcohol mixture With the increase in the extent of reaction the products become more and more mobile Above 70 per cent of the reaction the viscosity again increases until at about 97-98 per cent the substance becomes hard,

clear, insoluble and infusible solid The products in this case are dark coloured while those with the previous acids are white to pale yellow

The actual kinetics of the reaction are also somewhat different from those of the previous ones At lower temperatures (130°—150°C) the reaction follows a bimolecular mechanism i e, the activated complex consists of two molecules of acids, while at 170°C the reaction was a third order one This means that at lower temperatures the reaction is not catalyzed by a third molecule of the acid as is the case at higher temperatures But the change in the acid value, ester value, etc, are similar and in both cases the reaction is one of esterification

TABLE I

t (hours)	170°C		150°C		130°C	
	A V	E V %	A V	E V %	A V	E V %
0 25	95 8	42				
0 50	64 2	61	93 6	43	133 8	19
0 75	50 0	69	79 4	51	120 0	27
1 00	46 6	71	68 8	58	96 3	41
1 25	42 8	74	60 4	63	84 3	48
1 50	38 2	76	56 2	66	76 3	54
1 75			46 9	71	70 6	57

Further, above 200°C the reaction presents yet another peculiarity Although the reaction is very fast at the earlier stage, it becomes very slow at the latter stage and after about 3 hours the acid value actually begins to increase and the product never becomes insoluble or infusible This is most probably due to break-down of the polyester molecules at higher temperatures, a similar case has also been observed with 9 10 dihydroxy stearic acid polyester which breaks down at 300°C to dihydroxy stearic acid and a ketostearic acid [2]

Thanks are due to Dr P K Bose, Director, Indian Lac Research Institute, Namkum, Ranchi, for his keen interest in the present work

SADHAN BASU

Indian Lac Research Institute,
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29-6-1948

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IODINATION OF SODIUM ACETATE IN GLACIAL ACETIC ACID MEDIUM

THE types of organic compounds that can be subjected to direct iodination are rather limited Carboxylic acids, in general, do not react with iodine at room temperature with an appreciable speed Thus, if iodine is dissolved in glacial acetic acid, the resulting solution is quite stable for a long time But, it has been found in this laboratory that a solution of sodium acetate in glacial acetic acid, or sodium propionate in propionic acid and the like, readily reacts with iodine dissolved in the same solvent and proceeds with a measurable speed at ordinary temperature Presumably, it is the carboxylate ions that enter into direct reaction with iodine, whereas undissociated acid molecules are quite unaffected Physico-chemical aspects of the above reaction are being investigated and the salient features of the reaction noted so far are recorded below

The reaction gradually slows down with progress of time and a state of equilibrium is apparently reached in less than 24 hours The reaction rate depends on the concentration of iodine, as well as on that of the acetate, as found by varying the concentrations of both reactants separately within fairly wide limits The reaction has been studied both in light and in dark and photo-chemical reaction has been found to be absent at least in the visible region of the spectrum Small amounts of water added to the reaction mixture are found to be without any appreciable effect on the kinetics of the reaction One of the most interesting features of the reaction is that it is strongly retarded by iodides Another peculiarity that has been noted is the very low temperature co-efficient of the reaction, implying a rather unusually small energy of activation

The reaction with bromine in place of iodine is much faster and tends towards completion, but has otherwise similar features

The problem is being studied in its full details and the results will be published elsewhere

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Cultivation of Science,
Calcutta, 18-8-1948

Indian Science News Association

PROCEEDINGS OF THE THIRTEENTH ANNUAL MEETING

The Thirteenth Annual General Meeting of the Indian Science News Association was held on September 28, 1948 at 4-30 P M in the hall of the Applied Chemistry Department at the University College of Science, Calcutta

In the absence of Sri M M Sur, President of the Association, Dr D M Bose, Vice-President, was in the Chair and Dr P C Ghosh, Ex-premier, Government of West Bengal, was the Chief Guest

On behalf of the Secretaries, Prof P Rây submitted the following report of the working of the Association and the audited accounts for the year July 1, 1947 to June 30, 1948

ANNUAL REPORT

The Council of the Indian Science News Association have much pleasure in submitting this, the Thirteenth Annual Report and the Statement of Accounts for the period July 1, 1947 to June 30, 1948

MEMBERS AND SUBSCRIBERS

During the year 1947-48, there was an increase in one life-member making the total 112 and the number of ordinary members was 40, as against 45 of the previous year

The total number of copies despatched in June, 1948 was 1,454 as compared to 1 497 in the same month of 1947 The number of subscribers in June, 1948 including the members of the Association was 1,267 as against 1,310 of the preceding year We had to strike off 43 subscribers from the list Of these 27 discontinued and 16 were defaulters

EXCHANGE JOURNALS

The total number of copies of the journal sent out every month in exchange and for review was 67 We received in exchange 29 Indian and 23 foreign journals We also received journals of learned societies and publications of Government Scientific Departments We send the journal regularly to several Societies and Institutions on request Several Calcutta newspapers, *viz*, *The Statesman*, *Amrita Bazar Patrika*, *Hindusthan Standard*, *Jugantar*, *Bharat* and also the well known Madras daily, *The Hindu*, supply their daily issues in exchange as before

ADAIR, DUTT RESEARCH FUND

The following scholars engaged in research work noted below are enjoying scholarships from the above fund

(1) Mr P Nandi—Micro-biology (now in England),

(2) Mr Pranbandhu Dutt—Chemistry

We are grateful to Messrs Adair, Dutt & Co Ltd for financial help in getting a series of articles on the riverine systems of India written by one who has specialised in the subject

(For Statement of Accounts, see last page)

GRANTS

We are grateful to the authorities of the Burma Oil Company, National Institute of Sciences of India, University of Calcutta and the Bengal Chemical and Pharmaceutical Works Ltd for renewing their annual grants The amounts of these grants are as follows

Burma Oil Company (for 1947 and 1948)	Rs 2,000/-
Rockefeller Foundation	,, 1,000/-*
Government of India	,, 750/-*
University of Calcutta	,, 500/-
Bengal Chemical & Pharmaceutical Works Ltd	,, 500/-

DONATIONS

During the year the Association was fortunate enough to receive the following donations from Messrs Sur Enamel & Stamping Works and the Indian Association for the Cultivation of Science, for which we express our sincerest thanks to them

Messrs Sur Enamel & Stamping Works	Rs 1,000/-
Indian Association for the Cultivation of Science	,, 900/-

* Through National Institute of Sciences of India

Our thanks are also due to the authorities of the Calcutta University for accommodating the office of "SCIENCE AND CULTURE" in the University Science College building

CONCLUSION

As in the past years the editorial policy of "SCIENCE AND CULTURE" continued to be to make every attempt to focuss public attention on the importance of the application of science, scientific research and scientific methods to the social and economic problems facing our country Looking back into these past thirteen years we are encouraged by the fact that we have been able to a certain extent by means of our journal to rouse the public opinion for a higher standard of living, which can only be possible by the utilization of science for social ends and by scientific development of our natural resources

We are also not unmindful of the cultural aspect of our organ , for, many of the ills and evils, both physical and psychological, from which the humanity suffers today as the result of a disastrous and devastating war, cannot be eliminated unless the human mind is liberated from the maddening bondages of passions, pride and prejudices which reveal themselves in financial and idolatrous worship of set dogmas, favourite ideologies, circumscribed doctrines, and even of sentimental nationalism and material progress There is no wonder, therefore, that the society today has become a battle field for rival groups, communities and nations blinded by lust for power and greed for wealth What is, therefore, most needed today is a supreme regard for truth with guidance of reason, justice and tolerance This is possible only through the development of a serene and scientific attitude of mind, for which our "SCIENCE AND CULTURE" stands

The year under review has been one of acute financial stringency The increase in the cost of publication is mainly due to the high rates of printing In spite of these, we have been able to maintain a fairly high standard of our monthly journal "SCIENCE AND CULTURE" But we have not yet been able to undertake the publication of special numbers and maintain a library for want of adequate funds

We take this opportunity of expressing our grateful thanks to Dr Ramgopal Chatterjee, Sri Bibhuti Mukherjee and all others who rendered ungrudging services in various capacities for the Association

(For Statement of Accounts, see last page)

The following persons were unanimously elected officers and members of the Council for the year 1st July, 1948 to 30th June, 1949

President—Sri M M Sur

Vice-Presidents—Dr S C Law, Sir Jnan Chandra Ghosh, Prof M N Saha, Dr W D West, Sir Shanti Swarup Bhatnagar and Dr B Prasad

Treasurer—Prof P C Mitter

Secretaries—Prof P Ray and Prof S K Mitra

Members—Prof S P Agharkar, Dr B Ahmad, Sri H P Bhaumik, Sri S N Sen, Dr K Biswas, Dr P K Bose, Col Sir R N Chopra, Prof K P Chattopadhyay, Dr M S Krishnan, Dr B C Guha, Dr D S Kothari, Sri B N Maitra, Dr S C Mitra, Prof H K Mookerjee, Dr J N Mukherjee, Dr S R Bose, Dr S L Hora and Dr S Dutt

The Editorial Board of "SCIENCE AND CULTURE" for the next year was constituted with Dr D M Bose, Prof M N Saha, Dr A C Ukil and the two Secretaries as ex-officio members

Addressing the meeting Dr P C Ghosh stressed on the role of scientists in the amelioration of human sufferings and in the solution of the food problem in the country by improving our agriculture, livestock, etc He said that the results of scientific researches must be carried to the ordinary cultivator by disseminating such knowledge in Indian languages The problem of education in the country was stupendous as the literacy was as yet very low The Government must spend more money for the basic education as well as for scientific education of the people While he was the Premier it occurred to him that either the Government House, Calcutta, or the Presidency Jail at Alipur, could be sold off for six to ten crores of rupees and money thus released could be utilized for education and nation building projects

He said that they were not alive to the deplorable plight of the villagers Fundamental research was valuable no doubt, but the country needed today extensive research so that the results could be carried to the villagers and the agriculture, education and health might be improved

Congress, he said, had brought for the people freedom They still enjoyed their confidence But that confidence would be shakened if they failed to lift the village life from the ruinous state in which it was today Unless the scientists could employ their knowledge and skill to improve the condition they would soon lose their utility India today was a free country and scientists as others must assert themselves to do whatever was good for the people Government of a free country could not afford to lose co-operation of her scientists But scientists must be able to do something good , otherwise, they could not claim public or Government support

Dr Ghosh then gave a pen picture of the condition of life of the people of this province Scientists warned the common man not to use adulterated mustard oil But they did not tell them where to

get pure oil Milk, they said, must be pure But they did not tell the people where to get pure milk As to warn the people it was equally the duty of the scientists to tell the Government how to arrange for the good things Negative attitude must be shed Scientists told them people must have balanced diet But they did not tell the people how to work so that they could get balanced diet Again, scientists would tell them illiteracy must be removed But again, they remained silent as to how to educate the people Calcutta from a scientific point of view was inhabitable But scientists did not tell the Government how to make it habitable Village life was in a chaotic condition Yet, scientists did not say how to bring order in that chaos

So, he wanted the scientists to be alive to their part to be played in a free India They were pledged to democracy But democracy could only function where people were conscious of their rights and privileges

He impressed upon the audience that Mahatma Gandhi was against large-scale industrialization On the contrary, he supported such industry if it was utilized for the welfare of the masses and not for the exploitation of labour

Continuing he remarked that India was yet in need of eminent foreign technical experts for the development of scientific resources of the country A great paradox in India was that side by side with unemployment in a large scale there were dearth of real talented men who could take up constructive work with right earnest

Proposing a vote of thanks to the Chief Guest, Prof M N Saha said that the scientists in India were quite alive to the problems of the country and were ready to co-operate with the Government of the day in finding out solutions for them Scientists could formulate certain proposals for the solution of the problems but the carrying out of them vested on the Government He expressed the hope that given proper chance and opportunity the scientists in India would not belie the aspirations of the people From the very beginning, "SCIENCE AND CULTURE" has been focussing attention to various problems of development projects These have very often been utilized by the Government without proper acknowledgements The scientists were thus doing their best and it was for the Government and the Industrialists to act accordingly The Government must be honest in their projects He praised Dr Ghosh for setting up small institutions in villages where constructive work was being carried out

Prof S K Mitra said that in the free atmosphere of the country today scientists in India were determined to carry forward the task of reconstruction of the country in co-operation with the Government of the day

(Statement of Accounts, next page)

INDIAN SCIENCE NEWS ASSOCIATION

(Registered under Act XXI of 1860)

Receipts and Payments Account for the year ended 30th June, 1948

RECEIPTS

	Rs	As	P	Rs	As	P
To *Opening Balances on 1-7-47* —						
(a) At Bengal Central Bank Ltd in Saving A/c	502	2	5			
(b) At Bengal Central Bank Ltd in Current A/c	3,571	14	9			
(c) With Treasurer	229	7	8			
				4,303	8	10
,, Grant				4,750	0	0
,, Donation				1,900	0	0
,, Subscription				6,401	11	9
,, Ordinary Membership Fee				250	2	0
,, Life Membership Fee				145	0	0
,, Cash Sales of Journal				623	15	0
,, Advertisement				13,618	7	11
,, Reprint				594	1	0
,, Interest				3	11	1
				Rs 32,590	9	7

PAYMENTS

	Rs	As	P	Rs	As	P
By Establishment				7,789	0	0
,, Journal Printing				13,665	14	0
,, Paper				5,500	0	0
,, Postage & Receipt Stamp				934	15	0
,, Advertisement Commission & Publicity				768	6	0
,, Furniture (in full payment of cost of Typewriter)				352	10	6
,, Conveyance				35	5	6
,, Telephone				272	15	0
,, Miscellaneous				132	15	9
,, Stationery & Printing				197	15	0
,, Bank Charges				64	0	2
,, Audit Fee (re 1946-47)				60	0	0
,, Binding				33	8	0
,, *Closing Balances on 30-6-48* —						
(a) At Bengal Central Bank Ltd in Savings A/c	765	15	0			
(b) At Bengal Central Bank Ltd in Current A/c	1,914	15	9			
(c) With Treasurer	102	1	11			
				2,783	0	8
				Rs 32,590	9	7

AUDITOR'S REPORT TO THE MEMBERS, INDIAN SCIENCE NEWS ASSOCIATION

I have audited the above Receipts and Payments Account of the INDIAN SCIENCE NEWS ASSOCIATION (Registered under Act XXI of 1860) for the year ended 30th June, 1948, with the books and accounts and vouchers and have obtained all the information and explanations I have required I certify that the said account is correctly stated in accordance with the books of accounts of the Association

6, Old Post Office Street,
Calcutta, the 13th September, 1948

Sd P Ray,
Sd B C Guha,
Hon Secretaries

A K Ghosh,
Government Diplomaed Accountant
Registered Accountant
Auditor

Sd P C Mitter,
Treasurer

ADAIR, DUTT RESEARCH FUND

Receipts and Payments Account for the year ended 30th June, 1948

RECEIPTS

	Rs	As	P	Rs	As	P
To *Opening Balances on 1-7-47* —						
(a) At Bengal Central Bank Ltd in Savings A/c	5,270	2	6			
(b) With Treasurer	2	9	0			
				5,272	11	6
,, Scholarship Refund (A/c Sri K G Bagchi)				300	0	0
,, Bank Interest				14	6	9
				Rs 5,587	2	3

PAYMENTS

	Rs	As	P	Rs	As	P
By Stipend				2,750	0	0
,, Establishment				200	0	0
,, Accountancy Charges				15	0	0
,, Conveyance				1	9	6
,, Postage				0	4	6
,, *Closing Balances on 30-6-48* —						
(a) At Bengal Central Bank Ltd in Savings A/c as per Pass book	2,619	9	3			
(b) With Treasurer	0	11	0			
				2,620	4	3
				Rs 5,587	2	3

AUDITOR'S REPORT TO THE MEMBERS, ADAIR, DUTT RESEARCH FUND

I have audited the above Receipts and Payment Account of ADAIR, DUTT RESEARCH FUND for the year ended 30th June, 1948, with the books and vouchers and have obtained all the information and explanations I have required I certify that the said account is correctly stated in accordance with the books of the Fund

6, Old Post Office Street,
Calcutta, the 13th September, 1948

For Adair, Dutt Research Fund
Sd G Bhattacharya, *Treasurer*
Sd P Ray, *Secretary*

A K Ghosh,
Government Diplomaed Accountant,
Registered Accountant,
Auditor

SCIENCE AND CULTURE

A Monthly Journal of Natural and Cultural Sciences

Vol. 14 NOVEMBER 1948 No 5

DISINFLATION *CUM* COMPULSORY BORROWING BY GOVERNMENT

THE point cannot be too often stressed that great ages in the history of a people have been very often unstable ages First rate achievements by nations occur more frequently in years of instability than in times of security Such achievements are possible on our part in the present unstable times if we look at our problems from the point of view of the common man who would, in India to-day, rather face a dangerous future than a blank future The problem which the Government and the public view with the greatest concern at the present moment is that of inflation A commonsense remedy to combat this inflation is to withdraw a portion of the notes in circulation and compensate the owners by allotment of equivalent Government securities This remedy has, however, been looked upon with disfavour by a very influential section of the public and the Government has apparently been persuaded to accept their verdict The problem, therefore, requires closer study

Inflation has affected adversely

(*a*) the wage-earners in so far as their dearness allowances lag behind the cost of living index,

(*b*) the rentier-class in so far as the monetary returns from their holdings have been pegged, and

(*c*) the salaried and the professional classes

Inflation has favoured (*a*) the black-marketeers, (*b*) the businessmen who are hoarding goods and selling them in a market of rising prices and (*c*) the peasant proprietors who have surplus food to sell

From the speeches of the Hon'ble Ministers in Parliament and in public, it appears that Government are willing to strike those who have profited by this inflation, but they are either afraid to wound them, or have not yet been able to find out how to tackle them

The total note issue in India stands today at Rs 1250 crores approximately, as against an index of 128 for note circulation in 1940, which rose to 616 in 1945 The demand liabilities of scheduled banks now amount to about Rs 700 crores against which there is a liquid reserve of about Rs 100 crores The sum of Rs 1,250 crores, therefore, represent approximately the purchasing and lending capacity of our people But the goods which this purchasing power can buy are not there in quantities greater than they were in 1940, and hence the cost of living index has gone up to 390 This figure can be brought down either by increasing the availability of consumer's goods or by a substantial portion of this purchasing capacity being immobolised by long-term investment in projects of resource development A judicious investment of Rs 500 crores is expected to increase the annual national income at the end of five years by an equal amount The National Government should not, therefore, hesitate to resort to some forms of compulsory borrowing if appeals for voluntary investment in private enterprises or state-loans intended for resources development, do not meet with adequate response

The warning that compulsory borrowing would shake the credit structure of the country beyond repair, appears to be a myth, when examined in the context of what is happening in the world today Money before the World War I was a medium for the *free* exchange of commodities not only inside a country but also in international trade Hence

it had an intrinsic value Since then, however, in most countries money has been made an *instrument of state policy*—a servant and not the master of the State This has been achieved in U K by

(1) transferring the purchasing power from bank balances to ration coupons and

(2) by rigid control of export and import of goods both as regards categories and quantities

The capitalist and the middle classes in England have been always protesting against any crippling of the power of money and whenever any attempt has been made to do so, have raised the cry that England's credit is being rudely shaken and that the country is being led to disaster After World War II, these protests have carried little weight and a perusal of the White Paper on Capital Investment in 1948 shows that instead of the country being led to ruin, at no time in England's history the foundations of her prosperity have been more securely laid Out of an annual national income of £9,000 million, the following capital investments were made in 1947

	millions
Civil Engineering Construction	£ 850
Plant, Machinery and Vehicles	£ 610
Ship-building and miscellaneous	£ 90
TOTAL	£1550

In 1948, including agricultural improvements, the capital investment is expected to be of the order of £1,800 million which is 20 per cent of the national Income The upper and middle classes of England have the great virtue that they play the game, obey the rules laid down by their Parliament, pay their taxes and when hard pressed only mutter "Who dies, if England lives" It is obvious that by adhering rigidly to "austerity economics", U K has turned the corner and is now rapidly marching forward on the high road to prosperity

France would not have been in the doldrums in which she finds herself today, if she had followed the example of England In Belgium the volume of deposits and notes increased more than threefold during the war, and the Government thought it desirable to reduce the circulation of money to an amount which would be compatible with the level of wages and prices at which it was intended to stabilise them Accordingly the greater part of the volume of money was sterilised by blocking and withdrawal All notes of 100 francs and above had to be surrendered, and 60% of the notes so surrendered was blocked All bank deposits were blocked excepting 10% of the depositor's balance, 30% was then released gradually and 60% was blocked indefinitely Those who predicted dire consequences were found to be hopelessly in the wrong This courageous action gave the whole of Belgian economy an anti-inflationary orientation not only in regard to monetary circulation but also in regard to the level of wages It also created in the mind of workers a psychological situation which made possible wonderful progress in the recovery programme of the country By the end of 1947, Belgium's production reached pre-war level and by the middle of 1948 Belgium has made such recovery that she announced that she was prepared to give up the whole of the Marshall Aid to which she was entitled in favour of the less fortunate countries of Western Europe

In Denmark, Finland, Czechoslovakia, and Norway exchanges of notes together with a blocking of the old issues have been successfully undertaken For example, all notes in Norway above the denominations of one or two crowns were declared invalid in September, 1945 Of the notes presented for conversion, 60% was to be credited to a holder on a current banking account and 40% on a state account which could not be drawn upon without a permit from the Ministry of Finance

Money may be made idle and hence available for investment, if the purchasing power of consumer's goods is transferred from money to coupons as has been done in England By this device, it has been possible to operate successfully a *continuous process for the immobilisation* of liquid money In India, the administrative machinery which can do a similar job does not exist Nor have we the same spirit of discipline in our people But we can do something which is next best We can operate a *discontinuous but a periodic process which will immobilise liquid money* The underlying principle in both cases is the same, though the methods of operation are different It will be for Government to decide on a programme of capital development for a period of three years and then ascertain at the beginning of the period by actual loan operations how much of the cost of such development can be met by voluntary lending by the people The balance may then be secured by withdrawing a part of notes in circulation and cancelling a part of the demand liabilities of the banks and compensating the creditors by allotment of equivalent Government securities With this reserve, Government may create new money as and when necessary to finance its developmental programme during the period of three years The same process may be repeated at the beginning of the next three year period

Such a process has the disadvantage that a compulsory and rapid disinflation will be followed by a slow inflation, which will reach its peak at the end of three years, to be followed again by a compulsory disinflation and slow inflation in three year cycles

Such cycles of buoyancy and depression, are, however, not uncommon in systems of free enterprise, and if their recurrence is regulated by the State, they might be accepted without much hardship as a normal feature of our economic life There may be risks in such action, but few things that are worth doing can be done without some risk

Such periodical disinflation, by partial withdrawal of notes and freezing of demand liabilities of banks will have one great merit, which is not commonly appreciated Nobody will have any incentive to hoard consumer's goods The certainty that at the end of every three years liquid money will be in short supply, will operate in favour of bringing to the open market goods which, for some reason or other, may have gone underground This will be a check on the activities of black marketeers, and revive honest business methods based as much on motives of profit, as of service Controls become surer and easier of operation when there is an inherent tendency for goods to come out to the shop window

Development of Industrial Potential to Safeguard Independence

In the disturbed condition of the world today, there should be no slackening of efforts for safeguarding our independence It is now a universally accepted principle, that no nation can defend itself against modern weapon unless its industrial potential has been raised to a very high level and its productive units have been so planned that they can be switched over from peace time to war time activities at a short notice The highest priority should be given to industries related to defence They include schemes for the production of

(1) metals like steel, aluminium, magnesium, zinc and lead,
(2) synthetic petrol,
(3) heavy electrical and radio and electronics, telegraph and telephone equipment,
(4) machine tools,
(5) locomotives and rolling stock, ship and aircraft, mechanised transport,
(6) power and fuel,
(7) training of personnel

Equally important, if not more so, are schemes which aim at national self-sufficiency regarding food And in this category naturally are to be included all schemes for river-valley development, land reclamation, manufacture of fertilisers and agricultural machinery.

A modest estimate of capital which the Government of India should invest in State-owned enterprises in the period January 1949—March 1952 and from March 1952—March 1955 is given below

	Investment of Capital in State-owned projects of developments	
	Jan 1949—March 1952	March 1952-March 1955
1 Industry		
(a) Mining and Metal production	45 Crores	75 Crores
(b) Coal, Synthetic Petrol, Refineries, Power alcohol	40 ,,	60 ,,
(c) Factories for Heavy Electrical Equipment	6 ,,	10 ,,
(d) Factories for Light Electrical Equipment; Wireless, Electronics, Radar, etc	4 ,	6 ,,
(e) Machine Tool, Mechanised Foundry and Forge Shops	5 ,,	9 ,
(f) Fertilizers, Dyestuffs and Essential Drugs	30 ,,	45 ,,
(g) Shipbuilding, Aircraft, and Mechanised Transport	20 ,,	30 ,,
(h) Training of Technical Personnel	10 ,,	15 ,,
Total	160 ,,	250 ,,
2 Armament Factories & Defence Research	30 ,,	40 ,,
3 Agricultural Improvement including Irrigation schemes of multipurpose projects	140 ,,	230 ,,
4 Hydroelectric and Thermal Power Projects	40 ,,	60 ,,
5 Railways, Shipping, Airline & Communications & Roads	130 ,,	180 ,
GRAND TOTAL	500 Crores	760 Crores

Compared with the investment programme of U K which is being actually realised, how insignificant these estimates are! There are not however wanting friends to India who would even drastically cut down this programme!

The optimism of the ambitious planners at the end of the war has now given place to undue pessimism, and most people think that it will not be possible for Government to raise Rs 500 crores within the next three year period for investment in productive enterprises If unfortunately it happens that only a small part of the necessary capital can be obtained by ordinary loan operations, the balance will have to be secured by adopting more drastic procedures One such procedure has been indicated above

In 1945 the denominational pattern of notes in circulation in India was as follows

Percentage to gross circulation of all notes —

5 Rupee notes	10 Rupee notes	100 Rupee notes and above
12·8	35 3	50·2

On this basis, withdrawal of forty per cent of hundred rupee notes and above, and of twenty per cent of ten rupee notes, and their replacement by Government securities will mean a compulsory borrowing of Rs 340 crores Freezing and replacement by Government securities of 25 per cent of the demand and liabilities of scheduled banks will give another Rs 160 crores The difficulties of exchange for procurement of capital goods have been partly solved by the release of £180 million of sterling balances during the next three years But this sterling is the property of the Reserve Bank of India, and if used for financing Government demand for capital goods, its liquidation must be balanced by a corresponding withdrawal of notes from circulation

Raising the Production of Consumer's Goods

Government of India is pledged to a policy of mixed economy consisting partly of State-owned and partly of private enterprises It will not do to make provision only for the capital required by the State for its own needs Adequate resources must be made available for the expansion of private industries which are mostly expected to produce consumer's goods These cover a very wide field * It is the upper and middle classes who invest their savings in such industries The incidence of taxation should be such that their margin of saving should be sufficient for the end in view Contributions to Provident Fund and Insurance Policy are now free of income tax upto 16⅔ per cent of one's income subject to a ceiling of Rs 6,000/- This limit may be raised to 20 per cent The able business man has now no incentive for hard work as 97 per cent of his personal income beyond a certain level is payable as tax Government of India have in this case imitated U K practice But it should be remembered that such heavy incidence of income tax was introduced in U K only after free enterprise had so developed the resources of the country that the *per capita* income went upto about £140 a year If it is really intended that *entrepreneurs* in this country should have reasonable scope for the application of their talents then they should be left with at least 20 per cent of their income which they may risk in industrial ventures It is, therefore, suggested that income tax rules should be so modified that 20 per cent of the earnings of a person may be free from payment of income tax if invested in the Provident Fund, Insurance Policies and Industrial concerns approved by Government In India herd instinct reigns supreme in the investment market If an acknowledged leader in business invests his own money in an industrial concern, the smaller investors immediately follow suit and make the flotation a success

It is common knowledge that due to high prices of agricultural commodities, a large amount of liquid money has accumulated in the hands of peasantry who have surplus food to sell There is no incentive for him to grow more food because of the lack of consumer's goods like cloth, kerosene, building materials, etc , which he can obtain in exchange or the lack of bullion which he can hoard The peasant, however, is so fanatically attached to his holdings that he would do any amount of hard work to secure for himself the *Zemindary* rights on his land Most of the provincial ministries are pledged to the policy of abolishing zemindaries and vesting these rights in the State Such a policy is very sound theoretically, but the popular ministers should remember that it is only for administrative convenience that the British Government in India gave their support to Zeminders who acted as great shock-absorbers Prudence lies in not pointing in rosy colours the political implications of ryots dealing direct with Government A way out may be provided by considering seriously the possibility of vesting zemindari rights in the ryot himself Even the modest scale of compensation to zemindars adopted by many provincial Governments would run to many hundreds of crores of rupees and the Government of India have warned the provinces, that any loan that they may like to raise to finance *zemindary* abolition schemes should not conflict with the Centre's borrowing programme In the circumstances, for some years to come *zemindary* abolition will not be a practical proposition But the problem assumes a different complexion if the ryots are invited to pay compensation to the zeminders on a somewhat more generous scale, through Government agencies Such compensation may be paid by ryots over a period of five years in regular instalments This will bring out such an effort on their part to earn more that increased food production will become an assured reality and not a problematic venture as is now the cases The advantage of eliminating the annual import of food to the extent of Rs 100 crores a year in a country where 80 per cent of the people live on agriculture, can not be too strongly emphasised It is also natural to expect that a large part of the compensation which the zemindars may secure, will find an outlet in capital investment either in Government or in private enterprises A scheme involving zemindary abolition, increased food production and capital formation for industrial development and agricultural improvement ought to prove very attrac-

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*List of Major Industries coming under the Scope of Private Enterprise

1 Salt 2 Automobiles and tractors' 3 Prime Movers 4 Electric Engineering 5 Other heavy machinery 6 Machine tools 7 Heavy chemicals, fertilizers and pharmaceuticals and drugs 8 Electro-chemical industries 9 Non-ferrous metals 10 Rubber manufactures 11 Power and industrial alcohol 12 Cotton and woollen textiles, silk and rayon 13 Cement 14 Sugar 15 Paper and newsprint.

tive to economic planners, and deserves to be worked out in complete details

How to Tackle Tax-Dodgers

The problem of tackling tax-dodgers is everywhere very difficult Many newly-rich persons say that the fear of investigation by the Income-tax Enquiry Commission prevents them from utilising their money in developing productive enterprises or subscribing to Government loans Experience of cases handled by anti-corruption agencies of Government indicate that rich people often escape punishment which they deserve It would, therefore be more in the interests of the country if the Income-tax Enquiry Commission can collect say 100 crores of rupees by reasonable compromise with people suspected to be tax-dodgers and *complete its labours by the end of* 1948 This action coupled, if necessary, with a slightly higher rate of interest may bring about a satisfactory response to future flotations of Government loans There is no doubt also that the newly rich will then prefer banks to private custody for keeping their money Thus strengthened, the banks may take a more effective part in developing commerce, business and industry

In the recent discussions on inflation and its remedies, most people have looked at the problem through the spectacles of old orthodoxy They have forgotten that a revolutionary spirit is there in the land It will be a pity if the revolutionary fervour which has gained for us political independence subside on the slope of a barrier created by orthodox finance It is for our great leaders in the National Government to recognise that there is a tide in the affairs of men which taken at its flood leads to prosperity And it is for them to so guide this tide that it rolls over the obstacles put up by anti-social elements backed by static economic theories The prospects of developing the resources of the country are vast—as vast as we have the imagination to see But we cannot see such prospects from the bottom of a rut Heaven forbid that we be defeated today in our struggle for economic well-being But if we are, it will not be the mistakes of the Idealists but the cynicism of the Realists that will defeat us!

WEATHER AT COMMAND

WEATHER is so important for mankind that control of it by artificial methods has been a cherished dream since times immemorial But the earliest methods were those of magic, and were mere charlatanism The growth of meteorological knowledge during the past and present centuries did not afford prospects of any practical solution, because the fundamental knowledge of the process of condensation of water vapour into drops that form clouds, and difference between rain-bearing and non-rain-bearing clouds was lacking It has taken a long time to get to this knowledge, but even now all the physical processes are not clearly understood But on the basis of the little fundamental knowledge that has already been available, experiments on artificial rain-making have been started in the U S A and Australia, with a large amount of success if the reports in the daily papers are correct At any rate these two countries have taken to the experiments with a good deal of earnestness, and we learn from newspaper reports that the Army and Navy in the U S A, have jointly sponsored a scheme called 'Project Cirrus' for carrying out extensive experiments on artificial rain-making and allied problems and nearly ¾ million dollars were appropriated for this purpose in 1947-48 The results of these experiments will be awaited with success, unless the news is declared a prospective war-contraband

It is superfluous to point out the benefits which will accrue to mankind if an easy method of causing clouds to shed rain could be discovered For it has been found, in Australia and Chili (South America), and in the deserts of Rajputana in our own country, that very often heavy clouds pass for days together without shedding any rain, and there is no precipitation until some heavy obstruction like a mountain range was encountered by the clouds Such places are therefore unproductive deserts, whereas mountainous regions which obstruct the passage of clouds get too much water, which produces floods lower below, and most of the water gets lost either by evaporation, or by percolation Sometimes there may be cloud bursts in the wake of cyclones, causing flood and damage Clouds and fogs are the same things, and in high latitudes, fogs are very often a nuisance and may hinder traffic, and cause extensive damage to crops During the war, meteorological conditions have very frequently proved to be of very decisive importance and it is on record that during the last world war, some airports in Europe were so frequently enveloped in deep fogs, that they proved useless for the landing and taking off of aeroplanes and enormous

amounts of money were spent in expelling the fog by covering the ground with a net work of perforated tubing through which petrol was allowed to gush out burn and expel the fog The results obtained were extremely meagre in proportion to the expenditure It is now claimed that incomparably better success can be achieved by seeding the tops of clouds and fogs with a few pounds of finely powdered dry ice (solid CO_2) or fine dust of silver iodide

These reports have produced a certain amount of flutter in our own country for the daily papers published a report some days ago that a conference of hydrological engineers assembled at Simla some time ago and accepted a resolution that rain making experiments should be started in India as well

On account of the importance of the subject we have invited two relevant articles The first article is on 'Rain making experiments in Australia by Mr A K Roy M Sc Regional Director of Meteorology Alipore Observatory Mr Roy has recently been to Australia and New Zealand on an International Conference and took pains to obtain first hand information on 'Rain Making in Australia and delivered by invitation a lecture on his experiences at the Indian Association for Cultivation of Science Calcutta The present article forms a summary of his lecture The second article by Ft Lt K R Saha deals with the physics of formation of clouds and rains and is a summary of the fundamental work done on the subject during the war in England, U S A , and Germany, which are now being gradually released to the public

A perusal of these two articles will convince the reader that formation of clouds and precipitation of rain are extremely complex processes and inspite of the great strides made all the mechanisms are not yet clear Particularly competent scientific authorities are not yet agreed that Bergeron s theory of formation of rain drops which forms the basis of all rain making experiments in the U S A and Australia also hold for tropical countries like India Hence it is unsafe to rush to the conclusion that if a few pounds of powdered dry ice or silver iodide be sprinkled by means of aeroplanes on the top of any cloud it will be precipitated as rain

Even in the U S A and Australia only certain definite types of clouds are selected for experimentation by previous radar studies of clouds and the experiments are naturally controlled by trained physicists * We are of the opinion that a large number of laboratory experiments and field tests by competent physicists and meteorologists must first be carried out before the actual rain making experiments can be undertaken by trained engineers of the Army Navy and the Air

* In the U S A the Project Cirrus has the veteran physicist I Langmuir and Victor Schaefer as consultants for the experiments which are carried out under their directions by army and navy men

WARNING

like most species we are already encumbered by countless undesirable mutations from which no individual is immune In this situation we can however draw the practical lesson from the fact of the great majority of mutations being undesirable that their further random production in ourselves should so far as possible be rigorously avoided As we can infer with certainty from experiments on lower organisms that all high energy radiation must produce such mutations in man it becomes an obligation for radiologists—though one far too little observed as yet in most countries—to insist that the simple precautions are taken which are necessary for shielding the gonads whenever people are exposed to such radiation either in industry or in medical practice And with the coming increasing use of atomic energy, even for peace time purposes the problem will become very important of insuring that the human germ plasm—the all important material of which we are the temporary custodians—is effectively protected from this additional and potent source of permanent contamination

—*H J Muller*

RAIN-MAKING EXPERIMENTS IN AUSTRALIA . EXPERIMENTAL CONTROL ON THE YIELD OF RAIN FROM CLOUDS

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REGIONAL DIRECTOR ALIPORE METEOROLOGICAL OBSERVATORY

OF the numerous features of weather which occur in the Earth's atmosphere, the two which are most commonly met with, and yet interest us at all times are, firstly, rain and, secondly, clouds on which rain depends It is, therefore, only natural that since the time the study of synoptic weather charts with a view to forecasting weather became an important part of the activity of a Meteorological Service, these two elements have engaged much greater attention of Meteorologists than any other aspects of weather Yet, surprising as it may seem, there is much about clouds and rain which, till the present day, is not completely known to a student of Meteorology, notwithstanding the many interesting researches on the subject, especially during the present century

Clouds, as we all know, are of very different types, differing fundamentally in their form, general appearance, height of base, thickness, density, and lastly in their rain-giving capacity Similarly, rain that we have on different occasions varies very greatly in its character, not only in its total yield, but also in the rate at which the precipitation occurs, its distribution with reference to time, the size of water drops contained in the rain, etc Many interesting questions, therefore, arise in connection with the study of clouds and rain, and a keen observer from amongst the general public often asks

(*i*) What are the circumstances which lead to the development of different types of clouds over a station ,

(*ii*) How and why are the clouds of different kinds associated with precipitation of different character?

(*iii*) Why is it that rain on some occasions continues for hours together, while on others it ends with only one or two showers lasting for a few minutes?

(*iv*) How do we explain that on some occasions quite heavy rain is seen to fall at one station, although little or no precipitation occurs at a place only some five to ten miles away?

(*v*) What are the factors on which the intensity of precipitation depends?

and, lastly, the question which is the most puzzling of all

(*vi*) Why is it that low, dark and rather threatening clouds sometimes develop, and persist or drift slowly for hours together over a station, without yielding any rain, and yet on other occasions clouds, which are rather high, start precipitating soon after they appear over a place?

Indeed, it has to be observed in connection with the last question that even if we leave out the case of fog, which is really a cloud touching the ground, the lowest form of cloud proper, *viz* , Stratus (Fig 1),

FIG 1 Stratus Height of base is often only a few hundred feet above ground, yet no rain is received from the cloud (From *Cloud Atlas*, p 12)

whose base is often only a few hundred feet above the surface, does not, as a rule, give any rain and even when it does, the precipitation is in the nature

FIG 2 Fair Weather Cumulus As the name implies, the cloud is unassociated with rain, even when the base is sufficiently low. (From *Cloud Atlas*, p. 14).

of very thin drizzle Again, we have clouds, called 'Fair Weather Cumulus' (Fig 2) which, as its name implies, is not a rain-giving cloud, and in fact the predominance or persistence of this type of cloud on any day over a station may be taken to be an indication that no rainy weather is likely on that day On the other hand, we have Alto-stratus or Nimbo-stratus clouds (Figs 3 and 4) with base as high as

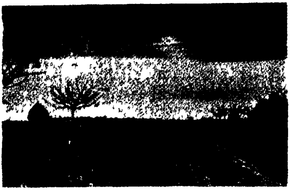

Fig 3 Alto-Stratus Though sufficiently high, measurable precipitation may be expected from this cloud, especially during winter (From *Cloud Atlas* p 9)

Fig 4 Nimbo-Stratus Has base much higher than stratus cloud as a rule, but is often responsible for prolonged rain of appreciable amount (From *Cloud Atlas*, p 13)

10,000 ft or more, which, in northern India, give prolonged precipitation at times during winter, and similarly Cumulo-nimbus cloud (Fig 5) with fairly high base at 5000 ft or above which, during summer, often gives heavy showers soon after its formation

While systematic observations of clouds and rain of the various types and their mutual association, and detailed study of the physics and thermodynamics of the atmosphere, which help their development, have since placed the Meteorologists in a position to give a fairly comprehensive and a reasonably conclusive answer to the first five questions, a final and complete answer to the last one is yet to be given, notwithstanding the fact that the matter has received the most careful attention of eminent scientists, physicists, physical chemists and meteorologists alike

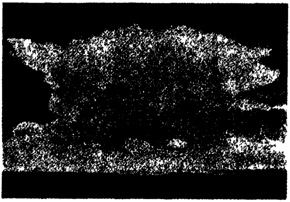

Fig 5 Cumulo-Nimbus With base at times much higher than 5000 ft above ground in summer, the cloud sometimes gives heavy showers amounting to an inch or more in an hour or less (From *Cloud Atlas*, p 17)

In their origin, clouds and rain are essentially the results of one and the same physical process, namely, condensation of water vapour in the atmosphere The real distinction between the two, however, lies in the difference in size, and hence in the rate of fall under

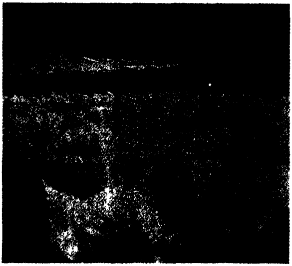

Fig 6 Cloud, as it was, before 'dry ice' was dropped (Photo taken during experiments in Australia) (From *Nature* April 12, 1947, p 489)

gravity of the condensation products at the two stages, and it is this difference which explains why the clouds which consist of minute droplets compared with the raindrops, appear to float in the sky while rain

falls on the ground. The questions which arise in connection with this topic are (*a*) where does the cloud stage end and the rain stage begin, that is, what is the minimum size to which cloud particles must grow before these can start falling as rain? and (*b*) why is it that the cloud elements in some cases grow to acquire the size of rain drops, and in others they do not? The fact that rain in some instances starts soon after the clouds develop, and in others no precipitation results even with clouds persisting for hours, shows that the time factor is apparently not so important in the growth of clouds into rain.

From experimental determinations and theoretical considerations by various workers in his field, it is now generally accepted that the cloud stage continues so long as the condensation particles do not attain a size bigger than 0.1 mm in diameter, and rain in the shape of thin drizzle starts only when the diameter reaches the value 0.2 mm. Table I below gives the diameters and fall velocities of water droplets at the different stages of clouds and rain, while Table II gives the distances through which water drops of different sizes must fall through an atmosphere, with mean temperature 5°C and relative humidity 90 per cent, before these get evaporated completely.

TABLE I

COMPARATIVE DROP SIZES AND FALL VELOCITIES OF VARIOUS TYPES OF CONDENSATION PRODUCTS

	Diameter Cm	Fall velocity M/Sec	Time taken in falling through a height of 1 Km
Cloud particles	4×10^{-4}	5×10^{-4}	More than 20 hours
	1×10^{-3}	3×10^{-3}	
	2×10^{-3}	1.3×10^{-2}	1 hour
	1×10^{-2}	2.6×10^{-1}	
Drizzle	2×10^{-2}	7.8×10^{-1}	20 mins
Light rain	4.5×10^{-2}	2.4	About 8 mins
Rain	1.0×10^{-1}	4.0	
Heavy rain	1.5×10^{-1}	5.0	
Very heavy rain	2.1×10^{-1}	6.0	
Cloud burst	3.0×10^{-1}	7.0	
Largest rain drops	5.0×10^{-1}	8.0	About 2 mins

TABLE II

DISTANCE OF FALL BEFORE COMPLETE EVAPORATION
(Pressure 900 mb, temp +5.0°C, R H 90%)

Diameter of drop Cm	Distance of fall before evaporation
2×10^{-4}	3.3×10^{-4}
2×10^{-3}	3.3 cm
2×10^{-2}	150 metres
2×10^{-1}	42 kms
2.5×10^{-1}	280 kms

It will be seen from the above tables that, with cloud base not higher than 150 metres above ground, the smallest size water droplets, which can reach the earth's surface without suffering complete loss by evaporation, must have a diameter of at least 0.2 mm, and that once the diameter of about 1 mm is reached, at least some part of the water drops will reach the ground as rain or drizzle even if the cloud is rather high, provided the atmosphere below is not too dry or there is no strong upward current to resist the fall of the drops. One thus sees that the essential pre-requisite for the development of rain from clouds is the condition which favours the growth of

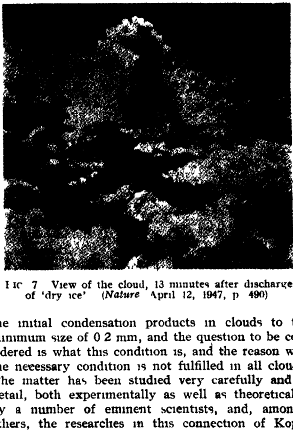

FIG. 7. View of the cloud, 13 minutes after discharge of 'dry ice' (*Nature*, April 12, 1947, p. 490)

the initial condensation products in clouds to the minimum size of 0.2 mm, and the question to be considered is what this condition is, and the reason why the necessary condition is not fulfilled in all clouds. The matter has been studied very carefully and in detail, both experimentally as well as theoretically, by a number of eminent scientists, and, amongst others, the researches in this connection of Kopp, Kohler, Defant, Neiderdorfer, and more recently of Bergeron and Findeisen deserve special mention.

The growth of the cloud droplets to bigger water drops has obviously to take place by (*i*) continuous condensation of water vapour on the original cloud elements or (*ii*) coalescence or co-agulation of a number of cloud particles or (*iii*) by a combination of both the processes. The possibility of either of the two processes operating in the clouds and thus helping the formation of drops of the required size to fall as rain was considered, but had to be discarded, as the necessary condition which would help such processes to occur on a large scale was, it was

thought, not satisfied in the cloud mass, as a rule The problem of rain formation, therefore, remained much of a puzzle for quite a long time, until Bergeron in the early thirties of the present century propounded his Ice-crystal Theory of precipitation to explain the growth of the cloud elements, at least initially, by the process of progressive condensation The theory of Bergeron gained further support by subsequent work of Findeisen on the formation of ice-crystals and on the physics of their further growth under conditions obtaining in clouds In brief, Bergeron's theory may be stated to be that precipitation of appreciable amount comes only from those cloud masses in which super-cooled water droplets and ice particles exist side by side at temperatures below freezing This means that, according to Bergeron, rain falls from only such clouds as extend well above the freezing level Bergeron's theory is based on the physical fact that, at temperatures below 0°C, the saturation vapour pressure with respect to ice is less than that relative to super-cooled water, the order of difference in vapour pressures at different temperatures being as indicated in Table III below

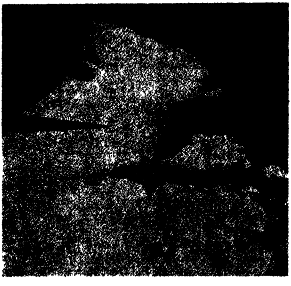

FIG 8 Cloud, with the small anvil formed about 20 minutes after discharge of 'dry ice' (*Nature* April 12, 1947, p 490)

TABLE III

VAPOUR PRESSURE AND RELATIVE HUMIDITY OVER ICE AND WATER

Temperature	0	10	−20	−40	−60°C
Vap pressure over water	6 11	2 87	1 26	189	020 mb
Vap pressure over ice	6 11	2 62	1 04	129	011 mb
Humidity over ice relative to water	100	91	83	68	56%
Humidity over water relative to ice	100	110	121	146	178%

As a result of the above difference in vapour pressures in a cloud at a temperature of, say, −10°C, with ice-crystals and water drops co-existing, the former, under condition of relative humidity of 100% with respect to water, will have round them a super-saturated atmosphere of the order of 10%, and will thus grow rapidly at the expense of the neighbouring water droplets The larger cloud elements formed in this way will fall more rapidly than the smaller particles, and while overtaking such particles, originally at a lower level and somewhat higher temperature, will coalesce with them and form still bigger drops Bergeron made a rough calculation of the rate at which a cloud consisting predominantly of water drops would change into a cloud of ice particles, assuming that there is one ice crystal to every eight water particles, and obtained an estimate of the order of 15 to 20 minutes The theory thus provided for the first time a reasonably satisfactory explanation for the speedy growth of cloud elements to rain-drops, to account for the heavy showers which sometimes start almost immediately after the tall thunderstorm cloud (Cumulo-nimbus) develops over a station

Observations of clouds and rain in Europe and other countries in extra-tropical latitudes lend a good support to the theory of formation of rain, as advanced by Bergeron It is quite a common experience in these latitudes to see that an appreciable amount of rain falls from relatively thin clouds in the cold season, when the ice-nuclei level is low, while comparatively thick clouds of the summer season fail to yield any precipitation Again, the clouds which form the core of most of the raining or snowing cloud systems in high latitudes are Alto-stratus or Nimbo-stratus, and both these clouds extend into the ice layer and have ice flakes and snow crystals in their upper levels The strongest confirmation of this theory—which, in a way, may also be considered an almost direct evidence in favour of Bergeron's hypothesis—is the sudden release of precipitation as Cumulus clouds turn into Cumulo-nimbus This process is almost invariably associated with the 'glaciation' of the upper part of the Cumulus cloud, which occurs rapidly with the sudden release, as it were, of a trigger when the cloud top reaches a certain level, presumably the ice-nuclei level As against these, sufficient evidence has, however, accumulated, which goes to show that quite heavy showers sometimes occur, especially in the tropics, from clouds, the tops of which are far below the ice layer In India, during the monsoon season when the freezing level is often above 15,000 ft, it is by no means a rare experience to see rain falling from clouds whose tops are not higher than 10,000 ft or so, and this experience, in recent years, has been confirmed by pilots of aircraft who, on ascending through some of the moderately

to heavily raining clouds, report perfectly clear sky from their position at 10 to 12 thousand feet above sea level Similar experience has been recorded by observers from planes taking meteorological flights and also other pilots of the United States of America, who have quoted a number of instances in which rain showers of the spring season occurred in a cloud deck whose temperature was well above freezing, and that the rain was indigenous to that cloud layer Thus, the present position of our knowledge about the formation of rain, *vis-a-vis* Bergeron-Findeisen's Ice Crystal Theory of Precipitation, is that, while measurable rain can and does occur at times from clouds which do not extend to the freezing level—and this is observed specially in the tropics and in higher latitudes during summer, when turbulence apparently plays an important part in bringing together cloud elements of unequal size and temperature—the co-existence of ice-crystals and water droplets in clouds, extending well above the ice level, greatly facilitates the release of rain, and perhaps plays the most important role in the majority of instances in which moderate to heavy rain occurs Once the position, as above, is accepted, many of the apparently anomalous features of rain formation from clouds begin to get clear to us, and we can see the reason why water droplets from such low clouds as Stratus do not reach the ground, and yet in summer large Cumulus or Cumulo-nimbus with base as high as 5,000 ft or more start giving rain soon after they form

Besides providing a very novel idea to meteorologists regarding the theoretical background of the formation of rain from clouds, Bergeron's ice-crystal theory of precipitation has, in recent years, evoked very considerable interest of the public in general, and of hydrologists, irrigation authorities and agriculturists, in particular, following the attempts that have been made by several countries during the last few years to apply Bergeron's idea in connection with their experiments on artificial stimulation of clouds to produce rain Considerable newspaper publicity has been given to reports about these experiments, especially from the U S A and Australia, and lately reports have also appeared in newspapers in India about schemes for undertaking similar experiments in this country in the near future A brief description of the general outline of the method followed in these experiments may, therefore, be of interest to the readers

The experimental procedure, as adopted by the workers in Australia, has been described briefly by Kraus and Squires [1] The method followed there and also in most of the American experiments, as known at present, is based fundamentally on Bergeron's hypothesis about rain formation, and consists chiefly in the discharge, from aeroplanes flying above, of 'dry ice' (solid carbondioxide) pellets in the upper layers of clouds whose tops have temperatures below 0°C No details regarding the Russian method are yet known, but what can be gathered from a few press reports, the artificial stimulation of rain formation in clouds is being attempted there by sprinkling particles of hygroscopic nature, such as, calcium chloride powder

Most of the experiments, so far carried out in Australia, have been made on well-developed Cumulus clouds, the parts of clouds chosen being those that have minimum depth of 5 to 6 thousand feet and whose tops reach a height of at least 2 to 3 thousand feet above the freezing level The principle underlying the dry ice treatment of these clouds to help rain formation is as follows Natural Cumulus clouds, with tops having temperatures as low as −10°C or even slightly lower, often have no ice crystals in them, and consist wholly of supercooled water drops The discharge in such clouds of dry ice powder with temperature of the order of −70°C causes the air and also the supercooled water particles in the clouds to be cooled by contact to a substantially lower temperature than the initial and, as a result, the water droplets begin to get changed to ice Chains of ice crystals appear in the clouds, which then begin to grow at the expense of the neighbouring water drops

In Australia, the experiments are carried out in a simple and straightforward manner, without involving the use of any special apparatus The main requirement is dry ice which is stored in large blocks in a double-walled chest On a day on which well-developed Cumulus appears over the area, one or two blocks are taken out and broken into small pellets about a quarter inch in diameter which are then packed in bags and carried to aircraft to be used for the experiments The plane takes off, and after making a thorough survey of the clouds selects the most favourable spot for the release of the dry ice About two to three hundred pounds of dry ice were used in connection with the earlier experiments, but later trials show that a much smaller amount, *viz* , 40 to 50 pounds apparently yields the same results Experiments in Australia have been carried out on a number of occasions since the beginning of 1947, and in the majority of cases in which the injection was made in clouds, with tops at temperatures below −5°C, the experiments have been reported to be successful The success achieved in a few of these cases has been quite spectacular, there having been rain of considerable amount for an appreciable length of time over the area in question as a result of the experiment, although little or no precipitation occurred from identical type of clouds in the surrounding country-sides Such successes were at

[1] *Nature*, April 12, 1947.

times associated with marked vertical growth of the cloud,—a development which is explainable on theoretical grounds as having been due to the heating of the affected cloud layer as a result of liberation of latent heat of fusion, and consequent growth of instability in the air layer above An interesting feature which has been observed in connection with these experiments is that the interval, which elapses between the infection of the cloud by dry ice and the development of rain patch within it, is usually about 18 to 20 minutes, which is in very good agreement with Bergeron's estimate of the time taken by water clouds to get changed into ice crystals

The rainmaking experiments, so far made, have yielded definitely promising results and we have now no reason to doubt that, under certain favourable conditions, it is possible to facilitate development of rain in growing Cumulus clouds by planting suitable ice crystal 'germs' in them A word of caution is however necessary, lest any one should be led to think that the time has already arrived when it is possible in all circumstances to make a practical application of the results of the above experiments in solving problems of drought or scarcity of rain in any season in a particular area It has to be remembered that in getting the desired rain with the help of such experiments, we have to depend on Nature for development of the suitable type of clouds and, further, it is necessary that, as and when such clouds develop, we should be ready with our experimental arrangements and that we should be able to complete the experiments while the clouds continue in an active stage of development It is most desirable that further intensive research in the laboratory and more and more field experiments under different conditions of cloud development should continue to be made in different countries, to enable us to obtain a fuller and clearer insight into the physics of rain, and thus devise surer means of controlling effectively the yield of rain from clouds

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CLOUD AND RAIN

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INTRODUCTION

NO natural phenomenon is more familiar to man than cloud and rain, and it is generally believed that they are very simple in character The description usually given in a text book would be something like this water from oceans, seas and other water surfaces, and land-features containing water, gets heated by the rays of the sun, some of it evaporates, and water vapour, being lighter than air, gets up vertically (Some of it may be carried miles away by horizontal wind, but that does not matter) As the water vapour ascends, it gets cooled by expansion, and is then condensed in drops to form clouds From clouds, whether they are stationary or carried by winds, rain is precipitated The rain water again finds its way through streams and rivers and underground to the ocean and the cycle continues, year in and year out

But it is not realised that the passage from one stage to the other, from evaporation to condensation of invisible water vapour in the form of minute droplets which compose clouds, and then coalescence of these droplets into rain drops, which are removed from clouds by precipitation involve physical processes that have caused headache to physicists for centuries and are not as yet completely understood The actual duration and completion of the cycle depends on many factors and they may be arrested at any stage

Rain is so important to mankind that many valuable observations, however desultory, have been made from times immemorial People have observed that there may be intense, gruelling heat day after day but not a speck of cloud is to be seen in the sky Where do all the evaporated vapour disappear? If they ascend, as they must, why do not they form clouds? They may be carried by wind to other regions, but this is not the whole case Then again clouds may pass one's sky for days together or may stand stationary for days and nights without giving a single drop of rain It becomes very tantalising especially when seasonal rain is expected and the yield of crops is dependent on timely precipitation Then sometimes, quite unexpectedly, there may be cloud-bursts over large regions, giving intense precipitation and causing devastating floods

People have wondered for ages about the vagaries of rainfall but rain is so important for human life that they could not remain inactive In all ages man has been trying to influence nature in their favour by all possible methods The earliest ones were those of magic The African savages, even till recently

had professional rain-makers, who at times when failure of clouds to shed rain became intolerable, performed magic rites accompanied by the blowing of horns to induce the spirit behind the cloud to shed the rains If they were successful the rain-maker would be greatly honoured and in some cases might be made the chief of the tribe but if unsuccessful he would be as often sacrificed to appease the spirit behind the clouds Similar rites were performed by other early people

In the *Rigvedas*, the oldest extant literature of the Aryans there are many beautiful verses describing the fight between the rain-god Indra who was also the king of Gods and the demon Vritra, who was supposed to hold up rains from clouds for days together, until Indra, by his thunderbolt would kill the demon, and the clouds would give beneficient rain On the day of the summer solstice, the traditional day on which monsoon was taken to burst, a high flag would be raised in honour of Indra When a region would be visited with continuous drought for successive years, it would be ascribed to some sin committed by the reigning king or the people, and elaborate sacrifices used to be undertaken to appease the wrath of Indra *

The object of this article is to describe in simple language how these mysteries of rain have been gradually cleared up, leading to the possibility that at no distant date, man will be able to control 'precipitation' and 'weather'

From Evaporation to Condensation

Let us now take the physical study of the cycle of phenomenon step by step

The first stages have been already described The invisible water-vapour is condensed into *'droplets'* on account of a fall of temperature due to ascent of the vapour This may also happen on the ground when on account of fall of temperature a "fog" is formed A fog is nothing but a lowlying cloud When water-vapour is carried very high up by an ascending current of air directly into heights where temperature is much below the freezing point, water-vapour condenses directly into ice-particles High clouds composed of 'Ice-particles' show 'Halos' under moonlight, while 'water clouds' show under certain circumstances 'rain-bows'

* Some of these beliefs persist even now, for sometime ago, while the writer was a student at Allahabad, a curious case was reported in the local papers There was a prolonged drought, and a *Bania* who dealt in food-grains reported to the police that he was roughly handled by his co-villagers The villagers said that the *Bania* had performed secretly some magic rites which consisted in getting an image of Indra buried underground, the objective being that Indra being absent, the clouds would pass without giving rain, the drought would be prolonged, and the *Bania* would get higher prices for his hoarded food-grains The villagers therefore contended that they were justified in giving a good beating to the *Bania* which was needed to force him to show the place where the image of Indra was buried They further pleaded that it was successful, for when the *Bania* was forced to point out the place where Indra was buried, they took out the image and propitiated it with magic rites, and rains followed!

The general description does not explain many points, and attempts were made in the last century by many investigators to elucidate them by laboratory experiments The most extensive ones were made by Aitken in the later decades of the last century,* and by C T R Wilson from 1897 to 1933

Cloud Making in the Laboratory

What Aitken did was to expand suddenly a volume of air standing over a water surface containing saturated water vapour into a larger volume This is not exactly what happens in Nature, for when air saturated with water-vapour goes up, say to a height of 2 kilometers, the pressure falls and the mass of air expands gradually in volume and the expansion is not large In the experiment, the expansion is sudden, and generally large However in this as well as in the laboratory process temperature falls, the air now becomes super-saturated, that is, it contains more water vapour than it can normally do and the excess amount of vapour is expected to be condensed in the form of small water droplets forming a cloud This was actually found to be the case in the laboratory experiment , but what surprised Aitken and other physicists was the fact that if expansion was done with the same air-mass in a limited volume, a number of times, then after a few expansions no fog would be formed even though these expansions were quite sufficient for producing super-saturation

This was traced to the surprising fact that *dust-particles* which are normally present in air and are considered a *nuisance* are *actually essential* for the formation of a fog In fact if the expansion experiments are carried out from the very start with dust-free air such as is obtained by sucking air through glass wool, no fog would be formed even at the first expansion In the experiments of Aitken, ordinary air was taken which contains enough dust particles After a few expansions these are all precipitated The air becomes dust free and no further fogs are formed after expansion

The explanation of this surprising fact was speedily forthcoming Lord Kelvin had shown in 1870 from thermodynamical considerations that the saturation vapour pressure of liquids over a curved surface such as small drops of radius 'r' was consider-

* Aitken's studies were first published in a tract "On Dust, Fogs and Clouds in 1880" In 1923, the results of investigations contained in this, and subsequent papers were published in the 'Collected papers of John Aitken' edited by C. G Knott, Cambridge Other workers were Coulier (1875) in France, and Richarz in Germany

ably higher than that over plane surfaces on account of the surface tension of liquids The relation is

$$\log \frac{p_r}{p_\infty} = \frac{2T}{r} \frac{M}{R\theta\rho}, \qquad \text{Eq (1)}$$

where T = surface tension, P = density of liquid, R = gas constant for the vapour, θ = temperature (absolute), and p_r, p_∞ are the saturation vapour pressures over drop and plane surfaces respectively

For a water drop at 10°C, the values of p_r/p_∞ calculated from the above formula for different drop sizes are given in Table I

TABLE I

VALUES OF p_r/p_∞ FOR DROPS OF WATER

r (cm)	2×10^{-8}	10^{-7}	10^{-6}	10^{-5}	10^{-4}
p_r/p_∞	316 2	3 162	1 127	1 012	1 001

This illustrates the need of existence of *nuclei of condensation* The H_2O-molecule has a radius of 2×10^{-8} cms Ordinarily in the process of cooling nearly 100 molecules of water must come together if they were to form a tiny droplet $\sim10^{-7}$ cm in radius But this would not be stable, as the above figures show unless the supersaturation exceeds 3 1, *i e*, the cooled atmosphere contains 3 times more water vapour than is given by the saturated vapour pressure curve In the absence of such supersaturation, the drop evaporates as soon as it is formed But if a dust particle having a radius of 10^{-6} cm is present, water molecules depositing on it form a droplet of radius 10^{-6} cm and now the super-saturation needed is only 1 12 which is generally to be found in cooled air So droplets formed by deposition of water molecules on dust particles will continue to grow The laboratory experiments prove that some kind of condensation nuclei must exist if cooled water-vapour is to form fogs or clouds under atmospheric conditions

ATMOSPHERIC NUCLEI—CLOUD FORMATION IN THE ATMOSPHERE

What are actually these nuclei on which clouds are formed in the atmosphere?

Dust is a very vague term which denotes minute particles of earth consisting mostly of sand or quartz particles carried upward by wind In addition, there may be other type of particles which may act as nuclei for condensation These are particles constituting smoke from industrial cities, particles of salt, like sodium chloride and magnesium chloride which are carried by wind over sea surfaces in the form of spray, these evaporating in the atmosphere, leave nuclei of minute particles of salt There may be, in addition, particles composed of oxides of nitrogen or SO_2, which are formed by the action of sun-light on oxygen and nitrogen molecules, or on sulphur nuclei which are found to exist in industrial areas

Some of these nuclei are hygroscopic, *i e*, can easily draw water to them The super-saturation needed for formation of drops on these hygroscopic nuclei are much smaller than on dust nuclei

In fact, laboratory experiments show that hygroscopic particles can gather moisture round them at relative humidities much below 100% Owens (1926) has described occasions when nuclei began to draw moisture at a relative humidity of 74%

How do these particles grow under such conditions? The earliest experiments carried out to answer this question were those of Kohler (1926) and the trend of his results is shown in Fig 1

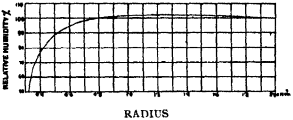


FIG 1 Size of condensation nuclei at different relative humidities

This curve serves to show that condensation increases with rise of relative humidity slowly at first, but very rapidly when the relative humidity approaches 100 per cent, or exceeds this value

It is natural to ask at this stage to what extent condensation can proceed on hygroscopic nuclei and what will be the order of the size of a drop formed in this way From our previous considerations we can try an answer to this question In the initial stages of absorption of water vapour the saturation vapour pressure on the surface of the drop decreases with increase of size, but at the same time the reduction of the salt concentration causes a rise in the saturation vapour pressure Thus two opposing forces come into play on the surface of the growing nucleus and further condensation stops when the two balance each other The maximum size of a droplet formed in this way has been estimated to be of the order of 10^{-5} to 10^{-4} cm in radius which is usually the order of size of an atmospheric fog or cloud droplet

There is yet another factor which we have to consider while studying the physics of drop formation It is the effect of electric charge on the condensation of vapour on a drop J J Thomson showed that if a drop contains an electric charge 'E',

the saturation vapour pressure on its surface is reduced The relation is given by

$$\log \frac{p_i}{p_\infty} = \frac{M}{R\theta\rho}\left(\frac{2T}{r} - \frac{E^2}{8\pi r^4}\right) \qquad \text{Eq (2)}$$

where the symbols have the same meanings as in Eq(1) If we put the right-hand side of Eq(2) equal to zero, it is easy to show that for every value of the radius there is what is called a critical charge which will make $p_i = p_\infty$, i e, it will reduce the saturation vapour pressure over the drop to that over a plane surface

The value of this critical charge calculated for different drop sizes is given in Table II

TABLE II

CRITICAL CHARGES FOR DROPS

r (cm)	4×10^{-8}	2×10^{-7}	4×10^{-6}	9×10^{-5}	2×10^{-3}	4×10^{-2}
E (charge)	1	10	10^3	10^5	10	10^9

Wilson (1897) using his cloud-chamber demonstrated the role of electrically charged particles in forming condensation nuclei in a supersaturated atmosphere He sent a high-energy charged particle like the α-ray from radium through a supersaturated vapour and by strongly illuminating the chamber photographed the track of the α-ray inside the chamber This was possible because in passing through the gases inside the chamber the α-ray owing to its tremendous energy knocked off electrons from the gaseous molecules and it was these electrons which because of their electric charge rapidly gathered moisture round them and formed the minute droplets which constituted the path of the α-ray under strong illumination Because of high electronic density, the saturated vapour pressure on the ions initially formed was considerably reduced and thus the supersaturation prevailing inside the chamber was sufficient to produce rapid condensation on them to form the visible drops

What is the order of electronic charges that can aid rapid condensation of water vapour on atmospheric nuclei? Table II shows that the critical charge for a drop of radius 10^{-6} cm which is the order of the size of average nuclei in the atmosphere is as large as 130 Multiple electronic charges of this high order are seldom met with on nuclei in the atmosphere There is evidence of multiple electronic charges on fog droplets and rain drops but the charge on atmospheric nuclei, at least in the early stages of condensation, seldom exceeds one electronic charge It is, therefore, rather unlikely that the effect of electric charge plays any important part in the formation of cloud drops in the atmosphere

It is thus recognised that some kind of 'Nuclei' is necessary for the condensation of water vapour into droplets which composes a cloud, but which kind of nuclei 'quartz particles' (dust), NaCl crystals obtained from sea-spray, or nitrous-crystals, play the predominant part is not yet decisively known

Actual size of Drops in Clouds

Further elucidation of the phenomenon depends upon our knowledge of the size of droplets forming clouds, and actual size and nature of the nuclei on which these droplets are formed

'Clouds' denote a wide variety of types, from low-lying fogs or stratus clouds which seldom give any precipitation to heavy rain-clouds enormous in extent, and yielding large precipitation Meteorologists have invented a system of classification, which has been accepted by the International Meteorological Committee and is published in the International Cloud Atlas The classification depends mostly on external physical appearance, location in the atmosphere and composition (whether they are made up of water-droplets or ice particles, or a mixture of both) (See Taylor, 276) The point we have to discuss is why some clouds vanish without giving rain, while others give copious precipitation

This is answered by a closer study of the size of droplets forming clouds

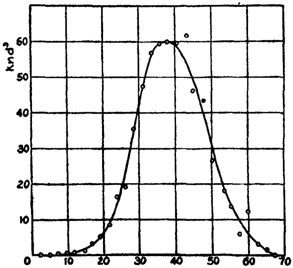


FIG 2 Abscissa diameter of cloud drops in microns, ordinate relative number of drops (From G F Taylor, Aeronautical Meteorology, p 261)

Measurements have been made of the size of droplets forming clouds by aeroplane ascents and other methods They are found to range in radius from 10 to 60 microns, about a mean value of 20 microns, in a fog, or low-lying stratus cloud.

The particles which are precipitated as rain have however much larger radii. They range in value from 100 microns (radius of drops constituting fine drizzle), to ¼ of a centimetre. Drops larger than these generally get broken by air during the fall.

The difference between clouds which hover, and disappear without giving any rain, and those which give rain is therefore entirely one of the dimension of the drops of which they are composed, the hovering clouds consisting of droplets less than $\frac{1}{10}$ mm in diameter, and the rain giving clouds consisting of larger drops. The cause is physically easily understandable. As soon as a drop is formed, it begins to fall down, under gravity, but its fall is arrested by the viscous drag due to air. For very small particles, the rate of fall according to Stokes' law is given by

$V = \frac{2ga^2}{9\mu}$ where g = gravitational acceleration, μ = viscosity of the air and a = radius of the drop. A cloud drop 10 microns in radius falls with a terminal speed of 1.3 cms, and it takes more than 20 hours in falling through one km. It, therefore, evaporates before it reaches the ground. The smaller the particle, the more slowly it falls, and, therefore, more quickly it disappears.

For a particle ¼ mm in radius, the rate of fall is about 2 metres per second and such a particle would fall one kilometre in 8 minutes and would not evaporate. For larger particles, the Stokes' law would not be operative, and the particles would move with accelerated motion. Table III adapted from a paper by Simpson (1941) makes these points clear.

The dividing line between cloud droplets which hover, but do not reach the ground, and the rain drops which reach the ground has been set by Simpson at $r = \frac{1}{10}$ mm, but others put it at ⅛ mm.

TABLE III

PARTICLE SIZES AND THEIR VELOCITY AND DISTANCE OF FALL

	Size of particles diameter (cm)	Velocity of fall (cm/sec)	Time of fall through 1 km
Molecules (H_2O)	4×10^{-8}		
Ions and Nuclei	1×10^{-7}		
	1×10^{-6}		
Cloud particles	4×10^{-4}	5×10^{-2}	—
	2×10^{-3}	1.3×10^{0}	21 hours
Drizzle	2×10^{-2}	78	20 minutes
Light rain	4.5×10^{-2}	200	8.0 ,,
	6.0×10^{-2}	260	
Heavy rain	1.5×10^{-1}	500	3.0 ,,
	2.0×10^{-1}	600	
Cloud burst	3.0×10^{-1}	700	2.4 ,,
Largest rain drops	5.0×10^{-1}	800	2.0 ,,

FORMATION OF ICE-PARTICLES (SUBLIMATION)

Not all clouds are, however, made up of water droplets. Observations show that high level cirrus clouds, appearing at heights of 6 to 12 kms where the temperature is below the freezing point, are composed mostly of ice-particles. Between clouds consisting entirely of water droplets, and those consisting entirely of ice-particles, there are however many other types, composed partly of water droplets, partly of ice. The surprising fact is that clouds consisting even entirely of water droplets are found on high mountain tops and in aeroplane ascents even when the temperature is much below zero, and are found to be of the same size as the fog droplets. These droplets are *'Supercooled'* and are therefore in unstable equilibrium. They generally transform themselves into ice-particles as soon as they strike against any solid obstacle, like aeroplane sides.

How are these ice-particles formed? Do they require nuclei for condensation (we may call them *sublimation nuclei*) just as water-droplets do under atmospheric conditions? Why does not water vapour form directly into ice-particles when the temperature is much below zero, but prefer, as observations seem to show, into supercooled "water-droplets" which may persist indefinitely?* These questions also occurred to Wilson in 1897 when he repeated Aitken's cloud-chamber experiments. It is only in recent years that these questions have been satisfactorily tackled by means of laboratory experiments.

"It is assumed that the cloud-particles are actually liquid drops and not ice crystals, in spite of the fact that the condensation begins at temperatures much below the freezing point (−15°C) and the temperature when the particles are fully grown is, as we shall see, also slightly below the freezing point."

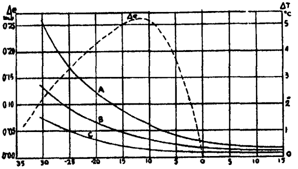
These laboratory experiments were taken up by Regener, and Findeisen in Germany and by Cwilong (1947) a Polish refugee physicist working in the Clarendon Laboratory, Oxford, under Prof. G. M. B. Dobson, during the World War II. The results of Cwilong given below are highly interesting for all theories of cloud formation.

The expansion chamber was placed in a cooling bath between 0°C and −10°C, with a supercooled liquid water inside. The air was freed completely from dust. The following observations were recorded.

(1) As long as the expansion was < 1.25, no fogs were formed, even when the temperature in the chamber fell to as low a value as −41.2°C. But when the temperature fell below −41.2°C, a shower of ice-particles were formed.

* Simpson (1923) records seeing in the Antarctic a fog or mist at a temperature of −29.5°C, producing a clear white rainbow. This rainbow requires for its formation a double reflexion within a sphere, hence the fog must have consisted of spherical water drops.

(2) When the expansion ratio was between the C T R Wilson limits> 1 25, but <1 38, only water droplets were formed as long as the chamber temperature is >-41 2°C Apparently they were formed round negative ions When T was <−41 2°C ice-particles were also formed in addition to water-particles, and the proportion of ice-particles increased as the temperature was made lower When the expansion ratio> 1 38, the C T R Wilson limit for condensation on ions of all signs, and T<-41 2°C, dense fogs consisting both of supercooled droplets and ice-particles were formed



AIR TEMPERATURE

FIG 3 Temperature Difference Effect at different Air Temperatures

With air containing *dust*, water droplets were formed at −32°C at small expansion, but when temperature fell below<-32°C, dense fogs containing both ice and water particles were found to be formed

On first considerations, the results appear to be highly puzzling and unexpected, but they have been found to be in agreement with cloud-observations

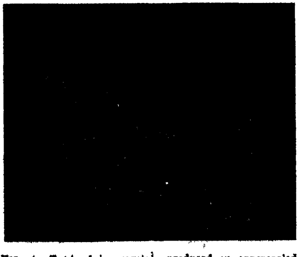


FIG 4. Trail of ice crystals produced in supercooled cloud by passing sewing needle cooled below −40°C (From *Bull Amer Met. Soc*, April, 1948, p 178)

Further these observations have been confirmed by Schaefer (1948) working in the U S A , and form the basis of the widely-advertized method of artificial rain-making (*vide* supra, article by A K Roy)

But this does not bring us to the end of our problems The natural question is (*i*) Why in the absence of sublimation nuclei, water vapour does not form into ice crystals until as low a temperature as −41 2°C is reached? (*ii*) How does the introduction of some kind of sublimation nuclei help in the formation of ice-particles at temperatures higher than −41 2°C? (*iii*) What kind of nuclei are most effective as 'sublimation centres'?

All these questions have not yet been answered satisfactorily and an attempt is made here to answer these It is commonly said that water freezes into ice below 0°C, but Langmuir (1947) thinks that this is not a correct description of facts Very pure water has been shown to be capable of being supercooled to −50°C A more correct description would be that once formed, ice cannot exist above 0°C Langmuir thinks that the spontaneous condensation of water droplets into ice-particles below −41 2°C can be explained as follows when we have a droplet of water of radius r, the pressure inside the drop due to surface tension$=2T/r$, if we consider a droplet formed of 12 molecules of water, $2T/r$ amounts to a pressure of 2000 atmospheres Now Bridgmann has shown that at about −36°C, and 2000 atmosphere pressure, a variety of ice crystal called Ice II appears This is probably what happens at −41 2°C If 12 molecules of water vapour come together at these temperatures they form a unit crystal of Ice II, and once such a sublimation nucleus is formed, water molecules deposit on it, and the crystal grows When it has grown sufficiently large, the Ice II transforms spontaneously into Ice I

As regards (*ii*) and (*iii*), probably the presence of a sublimation nucleus, on which a crystal of ice grows, helps in the prevention of evaporation just as in the case of water droplets But experience has shown that all kinds of nuclei are not equally effective, for injection of particles of quartz, salt, and many other substances were found to have no effect on production of ice-particles in supercooled spaces Cwilong found that supercooled drops do not transform into ice crystals when deposited on surfaces of mica, even at temperatures of −100°C but readily do so on zinc surfaces Apparently the nature of the surface and the crystal structure of the sublimation nuclei play a great role in this business

Vonnegut (1947) working in the M I T laboratories, found that crystals of Silver Iodide are particularly effective in promoting the growth of ice crystals, and AgI-crystals are reported to have been successfully used in artificial rain-making He was led

to the choice of AgI from his knowledge of principles of crystal growth that for the growth of crystals of some particular substance say water, substances possessing crystal lattices of similar structure and nearly identical dimensions are helpful, and minute dusts of such crystals, can act as very efficient sublimation centres for crystal growth

From Cloud to Rain

But how do the cloud drops, whether of water or ice, grow into rain drops? In Nature, the phenomenon of *condensation* cannot help us much as it gives us particles which are so small that they hover and evaporate before reaching the ground There must be some process by means of which the cloud droplets must grow into rain drops Taking the average radius of a cloud drop at 20 μ, we find that more than 125 of them are required to form the smallest rain drop, 100 μ in radius How does this take place in Nature, by coalescence, or by growth?

Fig 5 Ice crystals in chamber within thirty seconds Upper left shows part of unseeded supercooled cloud (From *Bull Amer Met Soc* April, 1948, p 179)

These matters have been hotly debated amongst meteorologists and the following processes have been proposed for the growth of cloud droplets into raindrops

(1) Hydrodynamical Attraction

Defant (1905), from his measurement of rain drop sizes concluded that a large majority of rain drops he measured grouped themselves chiefly in the mass ratios 1 2 4 8 Coalescence of droplets of the same size was given as the explanation of this observation Schmidt (1908) attributed this grouping to hydrodynamical forces and showed that if two droplets of the same size fall side by side a reduction of pressure occurs between them according to the Bernoulli principle and the droplets collide after descent through a certain height Stickley (1940) has used Schmidt's original equation to compute the time required for collision using different values for concentration of particles inside clouds These computations showed that with an average cloud drop concentrations it will require more than seven days for drops of radii 10^{-3} cm to form and 75 days for drops of radii 10^{-1} cm Even in the case of heavy cumulus in which the particle density is normally very high, it was found that more than 3 hours are required for the formation of drops of radii of 10^{-3} cms and over 32 hours for drops of radii of 10^{-1} cm It, therefore, appears that hydrodynamical attraction cannot be an effective factor to cause rain of any appreciable intensity in the atmosphere

(2) Electrical Attraction

It has been shown by Schmidt and Wigand from observations on fogs that electrically charged drops of the same sign do not coalesce and thus the uniformity of electrical charge is a strong stabilising factor Drops with charges of opposite signs attract each other but Bjerknes and his collaborators (1933) have shown that even with abnormally high charges and with the droplets almost touching each other the forces of attraction are rather small These workers have also shown that the electrical attraction due to induced charges under strong electrical field as in thunderstorms is also negligibly small

(3) Collisions due to Turbulence

Arenberg (1939) has shown that collision effects resulting from sudden change of velocity of an eddy turbulence in the atmosphere may be a very important factor in the growth of cloud elements into rain drops When an eddy cloud suddenly stops, particles of varying sizes moving with the eddy continue to move forward though the main eddy has stopped The motion occurs in such a way that the loss of kinetic energy of the particle must equal the work done by the viscous drag in the medium The forward velocity ahead of the stopping eddy is, however, different for particles of different sizes Arenberg calculated the distances that would be travelled by particles of different sizes and concluded that due to the path difference there would be numerous collisions to produce big drops In an average cloud, particles of all sizes exist and therefore collision would occur by eddy turbulence in the manner visualised by Arenberg It is possible that collision through turbulence is an important factor in the formation of rain But in the absence of sufficient observational data, the matter is still one for argument

(4) Differences in size of cloud droplets

Non uniformity of sizes of cloud elements can be an important factor in the growth of larger drops at the expense of smaller ones Equation (1) shows the equilibrium vapour pressure difference over drops of different sizes Therefore when two drops of unequal sizes exist side by side the difference in saturation vapour pressure between them would cause evaporation of water from the smaller drop and condensation on the larger. The larger drop would therefore grow at the expense of the smaller till the resultant equilibrium vapour pressure between the two is adjusted to a mean between the two individual vapour pressures. In the atmosphere droplets of different sizes are known to exist and it is therefore reasonable to hold that

the effect of non-uniformity of sizes of cloud elements does play a part in the formation of rain but Bergeron has pointed out that the contribution from this effect, by itself, is not likely to produce precipitation of any greater intensity than a light drizzle

(5) DIFFERENCE OF TEMPERATURE BETWEEN CLOUD ELEMENTS

Saturation vapour pressure of water as normally defined varies with the temperature Hence if droplets of different temperatures co exist a difference of vapour pressure would exist between them which cause evaporation from the hotter particle and condensation on the cooler till the equilibrium vapour pressure between them is adjusted to a value intermediate between the original vapour pressure of the droplets The difference in saturation vapour pressure for the same temperature difference between cloud elements varies, however, with air temperatures Fig 3 shows the effect in the form of three curves A, B, C

Curve A shows the temperature differences that would produce a saturation vapour pressure difference of 0 27 mb at different air temperatures, Curve B shows the same effect for a saturation vapour pressure difference of 0 13 mb, and Curve C shows the temperature differences required for a saturation vapour pressure difference of 0 054 mb at different air temperatures

It will be seen that at air temperatures above freezing a smaller difference in temperature between cloud elements is required to produce a given vapour pressure difference than at sub-freezing temperatures In the actual atmosphere, temperature difference between cloud elements occurs when different portions of the cloud are brought together by vertical mixing or when drops from the upper part of the cloud descends through the cold lower part Reynolds showed that the difference may result from the radiational cooling of the top surface of the cloud or differential heating by the Sun of different portions of the cloud This so-called Reynolds-effect is probably an important factor in the formation of rain in the tropics where a temperature difference of the order of 2°C or 3°C between neighbouring cloud elements and intense vertical mixing through great heights occur frequently in cumuliform and stratocumulus clouds

(6) THE ICE-CRYSTAL EFFECT

When drops of super-cooled water, and ice particles exist side by side, as in many clouds, it can be shown that ice crystals will grow at the expense of water droplets owing to a difference in vapour pressure Run of saturated vapour pressure for the two phases down to −60°C is shown in Table IV

TABLE IV

SATURATION VAPOUR PRESSURES OVER WATER AND ICE

Temperature (°C)	0	−10	−20	−30	−40	−60
Vapour Pressure over water (mb)	6 11	2 87	1 26	0 527	0 189	0 020
Vapour Pressure over ice (mb)	6 11	2 62	1 04	0 284	0 129	0 011

Suppose we have water droplets and crystals of ice at −30°C The S V P of water is 527 mb, and that of ice crystals is 284 If the vapour pressure in the space is 400 mb, the space is undersaturated with respect to water (R H =75 8), but supersaturated with respect to ice particles (R H =14) so water drops will evaporate and ice particles will grow at their expense

Bergeron was the first to postulate in 1933 that in such a co-existence of water droplets, and ice-particles lies the answer to the growth of ice particles to a size, when they can reach the ground as rain-drops According to him, rain is nothing but "melted snow"

The Curve Δe in Fig 3 shows graphically the difference in saturation vapour pressures over water and ice at different temperatures It will be seen that the maximum difference, 0 27 mb, occurs at temperatures about −12°C, below which the difference falls off rather slowly Thus over a considerable range of temperatures in which super-cooled water drops and ice crystals are found to co-exist in the upper regions of the atmosphere, the ice crystal effect is probably the most potent factor to produce large drops of rain

METEOROLOGICAL EVIDENCE

Since 1933, there has been a large body of evidence in favour of Bergeron's Ice-crystal theory Bergeron showed from considerations of colloidal instability in clouds that effects other than the Ice-crystal effect could not possibly account for precipitation of any greater intensity than light drizzle Surely those could not explain the sudden release of heavy precipitation from Cumulonimbus clouds which is so common in all latitudes particularly in the tropics Bergeron showed that the sudden release of heavy showers from Cumulonimbus clouds could be easily explained by his theory in that the upper portion of these clouds is almost always glaciated before heavy precipitation occurs Bergeron also points out the example of winter rain in high latitudes from low and thin clouds and absence of rain from clouds of greater vertical depth in the same latitudes in summer or from winter Cumulus in low latitudes The difference is due to the lower ice nuclei level in high latitudes in winter Bergeron maintains that any cloud from which appreciable rain is observed to fall must have contained ice crystals in its upper parts This means that in addition to the Cumuliform clouds, clouds like Nimbostratus or Altostratus which also give rain must contain ice crystals in those portions which are vertically developed in relation to the general top surface and extend into the layer of sub-freezing temperatures Ice crystals falling from Cirriform clouds into layers of medium clouds, as shown by Mare's tails or Virga, may also cause precipitation in accordance with Bergeron's theory But by far the strongest evidence has been assembled in favour of this theory by Stickley (1940) in America who showed from an analysis of 360 cases of reported rain observed by aircraft and on the ground that of the 324 effective observations practically all could be explained by the Ice-crystal theory Only 10 cases did not appear to support the theory but upon detailed investigation even those 10 cases could be explained away by the Bergeron theory

ACKNOWLEDGMENT

The author wishes to acknowledge his indebtedness to the writers of the various original papers, articles, and books from whom he has collected information to write the present article In the bibliography a few of the more important references are given He also wishes to record his indebtedness to the Officer Commanding, Elementary Flying Training School, A I A F, Jodhpur, for permission to publish this article

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INSECTS AND MITE PESTS OF JUTE*

G M DAS,

JUTE AGRICULTURAL RESEARCH LABORATORIES, DACCA E BENGAL

JUTE is an annual plant belonging to the genus *Corchorus* of the family Tiliaceae It is grown entirely for its fibre which is of great commercial interest throughout the world Only two species of *Corchorus*, *viz*, *C olitorius* and *C capsularis* are cultivated, the rest are wild

Jute is grown during the rainy season, being sown from late February to June, depending upon rainfall, type of land and varieties of jute grown It becomes mature in four or five months' time and is harvested from July until September

During this period *i e*, from the seedling stage up to the harvest the jute crop is subject to the attack of a large number of insect pests, including two mites (Acarina) which, though do not belong to the Insecta, are closely allied to them so far as their damage is concerned Even, the seed crop is not spared by some insects

The pests of jute may be classified into two groups —(1) Those responsible for deteriorating the quality of fibre and (2) those affecting the yield This, however, is not a strict division, as the pests responsible for deteriorating the quality of fibre also lessen the yield to considerable extent, whereas those affecting the yield lower the quality indirectly

The first group comprises the stem-weevil and the stem-sucking insects, the second group includes those which feed on the leaves or suck up the sap of the leaves, petioles and pods

The following is a list of jute pests recorded at Dacca

COLEOPTERA

CURCULIONIDAE	
1 Jute Apion	(*Apion corchori* Marshall)
BUPRESTIDAE	
2 Jute Buprestid	(*Trachys pacifica Kerr*)
EUMOLPIDAE	
3	(*Pachnephorus bretinghami* Baly
ELATERIDAE	
4 Wire worm	(*Agriotes* sp)

LEPIDOPTERA

ARCTIIDAE	
5 Hairy caterpillar	(*Diacrisia obliqua* Wlk)
NOCTUIDAE	
6 Jute semilooper	(*Anomis sabulifera* Guen)
7	*Laphygma exigua* Hbn.
8	*Prodenia litura* Fab
9	*Tarache crocata* Guen
PYRALIDAE	
*10 Jute Scopula	(*Scopula emmissaria* Wlk)

* Paper read at the monthly meeting of the Zoological Society of Bengal, held on 28-1-47 at Calcutta

HEMIPTERA

COCCIDAE	
*11	*Ferrisia virgata* Ckll
*12	*Phenacoccus* sp
*13 Black scale	(*Saissetia nigra* Nietn)
MEMBRACIDAE	
*14 Two-horned hopper	(*Otinotus elongatus*, Distant)

THYSANOPTERA

*15 *Thripidae*	(*Ayyaria chaetophora* Karny)

ORTHOPTERA

GRYLLIDAE	
*16 Giant Cricket	(*Brachytrypes achatinus* Stoll)
ACRIDIDAE	
17 Grasshopper	(*Attractomorpha crenulata* Fab)

ACARINA

TETRANYCHIDAE	
18 Red Mite	(*Tetranychus bioculatus* W M)
TARSONEMIDAE	
*19 Yellow Mite	(*Hemitarsonemus latus* Banks)

Practically, very little is known about the jute pests The only important article on some major pests of jute is by Lefroy (1907) Misra (1913) has recorded the red spider (*Tetranychus bioculatus*) on jute at Pusa Some other important pests are briefly mentioned by Fletcher (1914), Lefroy (1906, 1909), Chowdhury (1913), and Woodhouse (1913) A few were also discussed at the Entomologists' meetings held at Pusa (Fletcher 1917, 1919)

The real status of many of these pests is not definitely known Our study on the pests of jute not only records some new pests of great importance, but also places some minor pests in the list of major ones

As proper survey on the incidence and distribution of jute pests and the extent of damage caused by them has not yet been carried out, it is difficult to estimate the loss caused to jute by these pests, but it is considered to be very heavy when both the quality and the yield are taken into consideration An experiment designed and conducted at the Dacca Farm for three years on the extent of damage caused by some important pests *viz*, *Anomis subulifera, Diacrisia obliqua, Laphygma exigua* and *Hemitarsonemus latus*, recorded a loss in yield by about 20 per cent This does not mean that actual loss caused by the above mentioned pests is always the same in all jute-growing tracts, but it may be less or even more, as the extent of damage varies from place to place and year to year under different environmental conditions According to final forecast, the acreage under jute in Bengal (before partition), Bihar, Orissa and Assam was 21,03,955 in 1944 and 24,08,940 in 1945, the estimated total outturn being 62,03,205 and 71,65,535 bales respectively Assuming that the damage even to the extent of 5 per cent on an average is caused by all these pests, the total loss in yield in the four jute-growing provinces is roughly estimated at 17,91,384 maunds in 1945 In other words, if jute crop can be saved from the ravages of pests, 17,91,384 maunds in yield could be increased

* New record as pests of jute

BIOLOGY OF THE PESTS

1 Jute Apion (*Apion Corchori* Marshall)

Apion Corchori Marshall, commonly known as the jute Apion, is a very serious pest of jute, as its damage affects the quality of fibre It is widely distributed in all jute-growing areas of Bengal, Bihar, Orissa and Assam and has also been reported from Madras

Nature of damage—The damage is caused by the grub which feeds inside the bark, damaging the fibre-bundles The mucilaginous substance which oozes out as a result of injury, firmly binds the fibre bundles with the adjoining tissues together with the excreta into a hard mass, which greatly resists retting and ultimately forms a knot The fibre having such knots is known as "knotty fibre" In trade, the presence of knots forms an important defect in fibre quality

The place of attack can be detected by the swollen appearance and dark discolouration in the stem The shoot above the place of damage may wither and droop down, resulting in branching of the plant

Of the two cultivated species of *Corchorus*, the *olitorius* varieties are less susceptible This might be due to the presence of higher percentage of tannin in them The wild species are also more or less subject to the attack

Life-history—The female selects a place on the stem near the apex It bores a hole with the rostrum and deposits an egg in the hole Occasionally, the pod is also selected for oviposition The maximum number of eggs laid by a female during an oviposition period of 124 days was 675, the highest number being 13 eggs in a day The incubation period during summer months is 3 days The grub on hatching starts feeding on the tissues around it and may tunnel into the pith It is light yellow in colour with light brown head, 2 85 mm long and has a curved body It pupates inside the stem in a rough chamber made of excreta Duration of the grub stage is extremely variable, ranging from 8 to 18 days, according to nutrition available in the stem The pupal stage lasts 4 days and the adult comes out through the hole originally made by the grub during feeding or by making a fresh hole

The adult is a tiny insect, dull-black in colour, with the snout very conspicuous It breeds throughout the season on jute, but from July onwards it prefers to oviposit at the basal part of the stem *Triumfetta rhomboidea* has been recorded as an alternate host of the pest (Das, 1944)

2 Jute Buprestid (*Trachys pacifica* Kerr)

Like most of the members of the genus, the Jute Buprestid is a leaf-miner, occurring abundantly in all jute growing areas

Nature of damage —The damage is caused by the larva which feed on the mesophyll of the leaf, leaving the two outer membranes intact The damaged portion shrivels up, resulting in premature fall of the leaf

Life-history —The female deposits the egg near the margin of the leaf, especially at the tip The egg is covered with viscous material which is ejected along with it, hardens on exposure and protects the egg from injury A female can lay as many as 125 eggs during the course of one month The egg hatches in 3 or 4 days and the larva tunnels into the leaf tissues It feeds on the mesophyll without damaging the outer membranes The excreta is left all along the course of movement in such a way as to look like a net work of dark threads The mature larva is maize-yellow in colour and 1/5 inch long The body is compressed dorso-ventrally and the constriction between the segments is well-pronounced The head is conical and can be drawn into the greatly expanded prothorax The larva becomes full-fed in 6 or 7 days and turns into a naked pupa at the place where it stops feeding The pupal period occupies 4 days and the adult escapes by cutting an irregular hole in the upper membrane

The adult is a small beetle, 2 5 mm long, with the body compressed dorso-ventrally It has uniform colour, varying from light coppery hue to irridiscent blackish brown

It attacks the crop soon after germination and continues to breed throughout the season

3 *Pachnephorus bretinghami* Baly

Pachnephorus bretinghami is a small beetle, slightly bigger than the Jute Apion It appears on jute in the month of June or July and feeds on the bark of the growing shoot, damaging the fibre-bundles The damaged shoot develops a hard crust which resists retting and results in the formation of a peculiar kind of 'barky' fibre The pest also occasionally feeds on the petiole which dries up, resulting in premature fall of the leaf

4 *Agriotes* sp

The larvae of this insect attack the root of the seedling jute The attacked plants gradually wither away

5 Hairy caterpillar (*Diacrisia obliqua* Wlk)

The hairy caterpillar, commonly known as *bichha* or *sua-poka* is a very widely distributed pest in India and has innumerable food plants It is a major pest of jute and causes considerable damage to it It appears on crop when it is about 3′ high and ravages it for more than two months

Nature of damage —The young caterpillars remain gregarious for about a week and feed on the lower surface of the leaves and skeletonize them Afterwards, they gradually disperse over the field when they devour the leaves The caterpillars prefer mature leaves, but in case of bad attack, the plants are totally defoliated, and even the top shoots are sometimes eaten up

Life-history —The eggs are laid in clusters on the lower surface of the leaf A female moth can lay more than 1000 eggs in 3 or 4 nights The eggs hatch in 6 days and the young gregarious caterpillars skeletonize the leaves After 6 or 7 days they gradually disperse and rapidly strip off the leaves The mature caterpillar is 1½ inches long and has an orange-coloured body, with both ends black The whole body is covered with innumerable hairs The caterpillar becomes full-fed in 14 to 20 days and pupates under dried leaves or in crevices of the soil in a rough cocoon composed mainly of hairs and shedded skin The moth emerges after 9 days

6 Jute semilooper (*Anomis sabulifera* Guen)

The jute semilooper, commonly known a *Ghora-poka* or *Chhatka poka*, is the most destructive pest of jute It appears on crop when it is 2′ high and ravages it for two months It has three broods on jute but the second brood is responsible for causing more damage

Nature of damage —The young caterpillar on hatching starts feeding on the epidermal membrane of one side and mesophyll, leaving the other epidermal membrane intact As it grows bigger, the holes are eaten up and the edges of the tender leaves are bitten off Later on, the apical leaves are repeatedly eaten up, sometimes destroying the growing shoot In this way as many as ten plants may be damaged by a mature caterpillar in a day Unless compelled the caterpillar refuses to feed on the older leaves, but in a bad attack, the plants are totally defoliated, leaving the bare stems standing in the field

Repeated damages of the apical leaves check the growth of the plants and encourage side branches Internodes at the place of attack become shortened and weakened As the plants become branched, there is also loss of fibre at the time of extraction Both *olitorius* and *capsularis* varieties are almost equally susceptible

Life-history —Eggs are laid singly on the under surface of the leaves, distributed over a large area in the field The incubation period is 2 days The mature caterpillar is a typical semilooper, slender, green, having slightly yellow head with narrow dark green lines down the back and a wavy dark stripe along the side It measures 1½ inches in length The body bears short hairs arising from short white ringed black tubercles and possesses four well-developed and one rudimentary pair of prolegs Larval period ranges from 9 to 15 days Pupation occurs in a rough cocoon constructed by adhering dried leaves or soil particles with silk threads The pupal period ranges from 6 to 8 days

7 *Laphygma exigua* Hubner

This species is widely distributed and has a wider range of food plants It is a very destructive pest of jute in the seedling stage

Nature of damage —The young gregarious caterpillars web up the leaves of seedling plant, and skeletonize them The older caterpillars devour the entire leaves, and under favourable climatic conditions defoliate the plants The pest never attacks any crop which is above one foot high

Life-history —The eggs are laid in clusters covered with buff-coloured hairs on the under surface of the leaf The maximum number of eggs laid by a female was 1278 with an average of 461 eggs for thirteen moths Incubation of the eggs takes two days during the summer months The young caterpillars remain gregarious for a couple of days and then spread over the field The young larva is green having black head The mature larva is variable in colour, greenish or pinkish brown, with a dark dorsal stripe and a broad pale orchaeous spiracular line measuring about 1 inch in length It has five pairs of prolegs The larval period occupies 13 to 16 days Pupation takes place in the soil in an earthen cell The pupal period lasts 5 to 7 days

8 *Prodenia litura* Fab

Prodenia litura is a widely distributed species and has a wider range of host plants, both cultivated and wild It is a minor pest of jute but occasionally causes serious damage to it

Nature of damage.—The young gregarious caterpillars skeletonize the leaves The mature caterpillars strip off the leaves completely.

Life-history —The eggs are laid in clusters covered with buff-coloured hairs A female moth can lay as many as 1,500 eggs in 3 to 5 nights The incubation period is 3 or 4 days The mature caterpillar is about 2 inches long, with bright yellow dorsal and lateral stripes, each bordered by semilunar black spots The caterpillar becomes full grown in 17 to 21 days and makes a rough cocoon with the dried leaves, or burrows into the soil for pupation The pupal period is 7 to 9 days

9 *Tarache crocata* Guen

Tarache crocata has been recorded as a minor pest of jute

10 *Scopula emmissaria* Wlk

The caterpillars of this species are found in numbers on jute almost throughout the season, but they cause negligible damage

11 *Ferrisia virgata* Ckll

Ferrisia virgata is a fairly common mealy bug and has been recorded in India on a number of host plants, assuming the status of a pest in some cases It has been recorded for the first time as a pest of jute causing damage to *olitorius* crop, particularly those plants which were under selfing-covers for experimental purpose (Das, 1947)

Nature of damage —The damage is mostly caused by the nymphs which usually remain congregated around the mother and suck up the sap of the stem, pod, leaf and occasionally of the petiole (Das, Mukherjee and Sen Gupta, 1948) The injury caused to the stem results in the formation of wound-cork, due to which the fibre bundles resist separation at the time of retting The wound-cork also remains sticking to the fibre Actually, more damage is caused to the seed plants which do not put the usual number of pods The infested pods also do not grow to the normal size, become deformed and remain abortive

Life-history —The males are scarce and consequently parthenogenetic reproduction is a common phenomenon especially during the months of September and October The eggs are laid in an advanced stage of embryonic development and hatch in about twenty minutes after deposition A female can lay as many as 1,000 eggs during an oviposition period of two to three weeks after which it dies

12 *Phenacoccus* sp

This pest is also very often found along with *Ferrisia virgata* The damage is caused by sucking of the sap of the stem, pod, leaf and petiole The damaged stem produces barky fibre

13 *Saissetia nigra* Nietn

The black scale, *Saissetia nigra* very often attacks the mature plants When a large number of them are present on the same plant, the plant looks sickly

14 *Otinotus elongatus* Dist

This is a dull brown insect and can easily be recognised by a long posterior and two lateral thorn-like processes of the prothorax The eggs are laid in the bark of the stem, cut being made in a number of rows, with the result that the bark sticks to the fibre bundles The adults and nymphs also suck up the sap of the stem

15 *Ayyaria chaetophora* Karny

This species sucks up the sap of the leaves which turn yellowish and fall off prematurely

16 *Brachytrypes potentosus* Stoll

This is a very common burrowing species and occurs abundantly in the plains of Bengal and Assam It attacks the seedling crop and has been reported to cause considerable damage to jute during prolonged drought The seedling plants are cut at the base at night and are dragged into the hole

17 *Attractomorpha crenulata* Fab

This is a very common hopper on jute It attacks the young plants and causes more damage to the *olitorius* crop than the *capsularis*

18 Red Mite (*Tetranychus bioculatus* W M)

Tetranychus bioculatus, commonly known as the red spider or red mite, though not a major pest of jute, is nevertheless an important one as it is responsible for doing considerable damage under favourable climatic conditions It has a very wide range of food plants and is found throughout the year on different plants

Nature of damage —The damage is caused by the larvæ, nymphs and as well as the adult females by repeated punctures and sucking of the sap of the leaves which ultimately become leathery, turn yellow and drop off prematurely The *capsularis* varieties are more susceptible than the *olitorius*

Life history —The eggs are deposited singly in shallow depressions near the midrib or veinlets The egg hatches in 3½ days and the larva comes out through a slit at the side of the chorion The larva has three pairs of legs, whereas the nymphs (proto-nymph and deuto-nymph) and adults have four pairs of legs The larval stage occupies 2 days and the nymphal stages 2 days The males emerge earlier than the females The adults are scarlet in colour and can be seen briskly moving under a thin web of strands of silk on the under surface of the leaves.

19 Yellow mite (*Hemitarsonemus latus* Banks)

The yellow mite (*Hemitarsonemus latus*) is a very destructive pest of jute Owing to its minute size, it escapes the notice of the people and its damage is better known as a disease called 'Telenga' It is more prevalent in high land areas and causes more damage to the *olitorius* varieties than the *capsularis*

Nature of damage —The yellow mite attacks only the apical leaves which are still folded or just going to be unfolded The damage is caused by sucking of the sap of the leaves which crinkle, curl over and drop off prematurely, resulting in shortening of the internodes and encouraging side branches The growth of the plants is very much affected

Life history —The eggs are laid singly in depressions of the leaf The incubation period is only a day The nymphal stage lasts one and a half day of which the active period covers more than a day and the quiescent period is 6-8 hours The males emerge a few hours earlier than the females

Conclusion

The control of jute pests presents a difficult problem Firstly some pests pass the early stages of their life-history protected within the stem and leaf-tissues and as such are not affected by insecticides Secondly, the insecticides to be used against some pests must have rapid action, otherwise there is every risk of chemicals being washed away during the rains Thirdly, the cultivators are very reluctant to adopt such measures which incur some expenditure on their part, though it may prove profitable in the long run All these points were taken into consideration before suggesting measures for the control of jute pests, and some measures were recommended after a good deal of investigation at this laboratory The results were first placed at the 'pilot developmental work' for large scale trials under cultivators' conditions, and were finally passed on to the cultivators for adoption, after modifications or additions wherever necessary The measures recommended have not only been found effective but economical too, provided that they are adopted in time

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ON THE CHEMISTRY OF ANTIBIOTICS

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THE phenomenon of "One creature destroying the life of another in order to sustain its own" is noticed in every sphere of life, but it was the study on antagonism in mixed bacterial cultures that led to the present concept of antibiotics The term is not yet very clearly defined, and is being used[1] for a chemical substance derived from or produced by living organisms which in small concentration has the capacity to inhibit the life processes of micro-organisms But if any such substance is to be used as a systemic chemotherapeutic agent, it must have certain characteristics such as (i) a powerful and specific action against any bacteria, (ii) activity even in the presence of body fluids such as serum, pus and cerebrospinal fluid, (iii) resistance against tissue enzymes, (iv) chemical stability, (v) low toxicity, (vi) ready assimilability, (vii) slow rate of excretion and (viii) non-induction for the formation of resistant bacterial variants

SOURCES

In a search for antibiotics that may be of use in clinical medicine, surveys of enormous numbers of fungi, actinomycetes, bacteria, lichens and even higher plants, have been made But in most cases the products show no promise of being of use in medicine as they are often relatively inactive and/or are for the most part far too toxic The most important antibiotics now-a-days are penicillin isolated from *Penicillium notatum-chrysogenum*, streptomycin from *Streptomyces griseus* and tyrothricin from *Bacillus brevis* Many lichen acids have been isolated from various lichens and have been found to be active against tubercle bacilli (*cf*, Barry and McNally[2]) Similarly juices of many higher plants afford antibacterial principle inhibiting the growth of various gram-negative pathogens, and even of *Mycobacterium tuberculosis*, but are quite toxic for animals It may be said that although so large a number of antibacterial substances has been isolated in different countries from divergent types of fungi, seldom an antibiotic possessing all the necessary characteristics of a true chemotherapeutic agent has been found From this it appears that the examination of the fungi has been in general disappointing.[3] Much interest is, however, being directed towards the study of bacteria as a possible source of antibiotics useful in medicine Search may also be made in the plant system for the isolation of an antibiotic active against acid-fast organisms. In the meantime attention should be drawn towards the synthesis of various chemotherapeutic agents possessing the structure akin to the natural antibiotics isolated from one or other source

CHEMISTRY

Penicillin which satisfies most of the requirements of a dependable chemotherapeutic agent is being claimed to possess the structure (I), where R represents different groupings giving rise to different penicillins all of which have been isolated and characterised Table I shows the types of penicillin and their sources The International Standard now is Penicillin G and the International Unit (*cf*, Veldee *et al*,[4]) is defined as the activity of 0 6 microgram of crystalline penicillin G as measured against one of two specified strains of *Staphylococcus aureus*

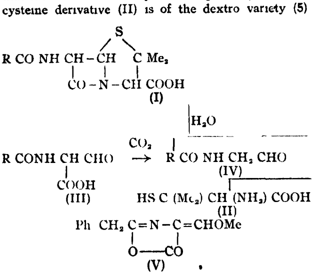
TABLE I

TYPES OF NATURAL PENICILLIN

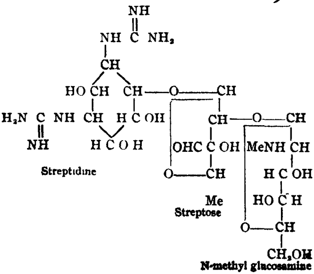
Name	R	Source
Flavicin	$CH_3CH=CH\cdot CH_2\cdot CH_2$	*A flavus*
Dihydro F	$CH_3CH_2\cdot CH_2\cdot CH_2CH_2$	*A giganteus*
I (I)	$CH_3\cdot CH_2\cdot CH=CH\cdot CH_2$	*P notatum-chrysogenum*
G (II)	$Ph\cdot CH_2$	Do
X (III)	(p) $HO\cdot C_6H_4\cdot CH_2$	Do
K (IV)	$CH_3CH_2\cdot CH_2\cdot CH_2CH_2\cdot CH_2\cdot CH_2$	Do

Penicillin (G) has now been synthesised[5] But the low yield and the tedious method required, indicate that it would take some time before the natural one would be faced with any competition with the synthetic product But biological production too requires a large amount of equipment, materials, well-equipped laboratories and high engineering technique Further evidence has been gradually accumulating that crude penicillin contains some factor in amorphous condition which markedly enhances its biological activity Differences in the chemical nature of R (*Vide* Table I) of the natural penicillin (I), of course, make them differ quantitatively in activity both *in-vitro* and *in vivo* (cf, Tompsett *et al*[6], Eagle and Musselman[7], and Hobby *et al*)[8], but on chemical treatment all of them undergo similar changes Thus, on acid hydrolysis penicillin gives an amino acid penicillamine (II) ($\beta\beta$-dimethyl cystein), one molecule of carbon dioxide and an aldehyde (IV) The carbon dioxide is obtained from penaldic and (III), the α-carboxy derivative of penilloaldehyde (IV). The

synthesis of the penicillin G has been carried out by condensing penicillamine (II) with 2-benzyl-4-methoxy methylene 5(4) oxazolone (V) As both these constituents (II) and (V) can be modified, a number of penicillin like compounds can be synthesised Work is already in progress in this direction in various countries It must, however, be mentioned that the antibiotic activity is developed only when the cysteine derivative (II) is of the dextro variety (5)



Streptomycin —Although many actinomycetes and related forms have been studied for the isolation of antibiotics (*cf*, Burkholder[9]) *Streptomyces griseus* has created special interest It affords streptomycin of the formula $C_{21}H_{39}O_{12}N_6$, (*cf*, Kuehl *et al*[10]) which on acid hydrolysis yields streptidine (1,3-diguanido-2,4,5,6-tetrahydroxy cyclohexane), N-methyl-glucosamine and a monose-streptose The latter two is glycosidically linked to form streptobiosamine which is again linked glycosidically to the cyclohexane part of the antibiotic The different entities of streptomycin are shown below



Streptomyces griseus however produces other antibiotic not effective against gram-negative bacteria and whose constitution has not yet been revealed (Waksman, Schatz and Reilly[11])

Tyrothricin —Quite a large number of antibiotics has been uncovered from the culture of *Bacillus subtilis, brevis* and other groups, but their complex chemical nature has made their purification difficult Tyrothricin from *B brevis* has been more extensively studied and is being found to consist of 20-25 per cent of a complex cyclopeptide[12] of the formula $C_{148}H_{210}O_{26}N_{30}$ with a high content of tryptophan, and 60 per cent of another amino acid complex of approximate composition $C_{126}H_{166}O_{26}N_{26}$ They are known respectively as gramicidin and tyrocidine, and their approximate composition would be evident from Table II The activity of the compound tyrothricin

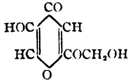
TABLE II

Gramicidin D		Tyrocidine	
Component	No of Residues per molecule	Component	No of Residues per molecule
L Tryptophan	6	L-Ornithine	2
D Leucine	6	L-Proline	2
L and D- Valine	5	L Leucine	2
L Alanine	3	L-Valine	2
Glycine	2	L-Tryptophan	2
Ethanolamine	2	L-Tyrosine	2
		L-Aspartic Acid	2
		L-Glutamic Acid	2
		Labile Ammonia	3
		D Phenylalanine	3

may be due to the inhibition of bacterial growth on the grounds of structural similarity with essential metabolites The occurrence of dextro variety of amino acids may be noticed in both the peptide parts of the antibiotic—Tyrothricin

Chemical nature of other antibiotics —The success of penicillin in clinical therapy set various scientists all over the world on the task of finding a still better antibiotic For this extensive investigations have been carried out only in vain to find out anything better than penicillin A study of the various antibiotics has, however, revealed the nature of chemical linkages that are responsible for the inhibition of the growth of the bacteria The antibiotic activity of Kojic acid, 5-hydroxy-2-hydroxymethyl -γ- pyrone (VII) which was first isolated by Saito[13] as a by-product of the fermentation of steamed rice by *Aspergillus oryzæ* and whose constitution was established by Yabuta[14] as early as in 1924, has been found by Morton[15] *et al* to be weakly active against a large number of gram-positive and gram-negative bacteria

It is also toxic to laboratory animals and man. Another substance isolated from *Aspergillus flavus* is aspergillic acid (VIII)[16] and is active even against human strains of *Mycobacterium tuberculosis*. Several species of *Aspergillus* as well as of *Penicillium* afford a product known under the names of Clavacin, Clavatin, Patulin, Expansin or Claviformin in different countries. It has been extensively studied and chemically is found to be an anhydro-3-hydroxy methylene-tetrahydro -γ-pyrone-2-carboxylic acid (IX). The above fungi also produces penicillic acid (X) which is somewhat toxic but effective against both gram-negative and gram-positive bacteria.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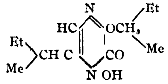
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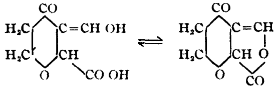
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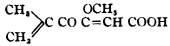
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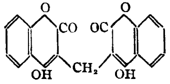
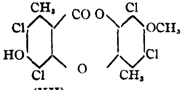

(XI)

Besides these many coumarines, flavones, quinones and substances containing unsaturated lactone structures have been found to exert some antibiotic activities. Amongst these 3, 3'-mythylenebis (4 hydroxy coumarin) (XI), has marked antibacterial action against various gram positive bacteria[17] but it is inactivated by cysteine[18]. The compound is better used as a synthetic anticoagulant (cf. Dhar and Basu[19]) in order to reverse the thromboplastic effect of penicillin and streptomycin.

Another type of compound is being isolated from a study of the antibiotic properties of certain lichens (cf., Stoll *et al*[20]). Usnic acid, $C_{18}H_{16}O_7$ m.p. 193-194° isolated from 15 species of lichens is being found to be active at a dilution of one part per million. Marshak *et al*[21] have again isolated another crystalline monobasic acid from lichen *Ramalina reticulata* which is again active against a wide variety of acid-fast organisms. Tuberculostatic activity has also been noticed[22] in the derivatives of diploicin (XII) isolated from the lichen *Buella canescens*. These suggest a thorough examination of lichen acids.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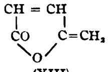
(XIII)

Researches of Cavallito *et al*,[23] Rao *et al*[24] and Basu and Sen Gupta,[25] reveal that antibiotic substances may be isolated from common plants onion and garlic. Garlic cells contain a substance which is rapidly broken down to the active agent—a colourless oil. Similarly investigations of Seigal and Holder[26] on buttercups have led to the isolation of a simpler antibiotic substance in protoanemonin, $C_5H_4O_2$ (XIII) which Baer *et al*[27] have extracted from the plant *Anemone pulsatilla*. Another type of antibiotic substances is being noted in chlorophyll as isolated from higher plants (*cf.*, Bose and Sen Gupta[28]). The observations of Bose[29] on the presence of a thermostable substance active against both gram-negative and gram-positive bacteria in the extracts of *Polystictus sanguineus*, suggest a study on the basidiomycetes too.

Synthetic Formation

Many antibiotic substances are very toxic to animal tissues and have other disadvantages too. It would naturally be of much interest if some non-toxic active component may be synthesised that would be lethal to the etiological agents of some diseases particularly tuberculosis, diphtheria and typhoid fever. For this apart from the structures of known antibiotics the mode of their action in inhibiting the microbial growth should preferably be established. A widely accepted theory suggests that many antibiotics function chiefly because of their ability to interfere with the sulphydryl groups of enzymes concerned in bacterial metabolism[30, 31, 32]. They also interfere with the bacterial respiratory systems and thereby inhibit the synthesis of essential cell components. Often they deprive the mineral requirements of the organism[33]. Researches of Geiger and Conn[31] Cavallito and Haskell[34], and Rinderknecht *et al*[35] on αβ-unsaturated ketone type of antibiotics (Clavicin IX, penicillic acid X) and that of Geiger[36] on certain quinones show that the mode of action of gram-positive organisms differ from that of gram-negative organisms. It appears, therefore, that the antibiotics

interact with a number of enzyme systems or metabolites essential to the bacterial cell

With all the above knowledge and with the examination of many naturally occurring antibiotics we will have a broad pattern of the types of substances that would fall in the above group The presence of unsaturated lactone or lactam ring carrying ethylenic or carbonyl radical, methoxy or other ether group attached to the unsaturated C-atom of the ring, the influence of alkyloxy, hydroxy or chlorine group, and in short some sort of association of resonance in the molecule have so far been noticed It may now be expected that with a little more knowledge of these linkages and groups, chemists would be able to prepare newer antibiotics possessing all the merits and none of the demerits of natural antibiotics

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INCIDENCE OF SMALL-POX IN CALCUTTA AND ITS DEPENDENCE ON SEASONAL FACTORS

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IT is well-known that small-pox breaks out in the City of Calcutta in a more or less explosive form with the advance of winter, continues increasing in the cold season and gradually falls off as the summer advances Every season is not, however, an exact repetition of any other so that the growth and decline of the disease may be accelerated or retarded by weeks An attempt is made here to determine the influence of the various seasonal factors on the occurrence of small-pox (attacks and deaths) in Calcutta and also to predict, to a limited extent, the course of the disease from a knowledge of the seasonal factors prevailing in the period under investigation

Certain assumptions have to be made to simplify the complexities of the problem and the typical course of the disease furnishes a pointer to them When a person is infected no visible signs of infection appear for the next twelve to fourteen days, after which fever sets in and on the third or the fourth day of fever the characteristic eruptions of small-pox appear, if the patient dies, he dies after twelve or thirteen days more, assumed to be the average period, so that a small-pox death is the result of infection contracted about a month or four weeks earlier Thus the number of deaths or the death-rate in a given week or month will depend on the seasonal factors, prevailing about four weeks or one month earlier, the subsequent seasonal changes being supposed to have no effect on the course of the disease The assumptions are

(1) If there is a sensibly constant case-fatality rate in a given year so that the number of deaths in a week or month will be proportional to the number of attacks about four weeks or a month earlier, then from the numbers of deaths we can compare the numbers of attacks As the data of attack from this disease are admittedly an under-estimate, some such assumption is necessary if we decide to study the effect of the seasonal factors on the number of attacks

(2) (*a*) Vaccination has undoubtedly a preventive effect on this disease but on account of the predilection of the people at large for getting themselves protected only very late when the disease has already got a firm foot-hold and on account of vaccination not being immediately effective, the disease has a start of several weeks before vaccination is allowed to make a headway, so that one year's vaccination has hardly any appreciable effect, except perhaps at a late stage, on the attack-rate and death-rate in that year The effect of vaccination has in most of the Tables been neglected

(*b*) Besides, the abnormal conditions and the absence of an epidemic of small-pox in the City during 1946-47 (due to the vaccination campaign conducted by the Corporation and A R P staff during 1945-46) were not conducive to a successful vaccination season Large numbers of people, mostly without the benefit of vaccination, have swelled up the population of 21 lacs (1941 Census) to more than double its bulk Hence where vaccination has been taken into account (as in the last two Tables) the proportion of unprotected people at the start of the epidemic has been taken as unity

(3) Uniformity of infection with uniform population density has been assumed, the physical criterion being that, at any stage, the attacked persons should be uniformly distributed over the uniformly populous area in question This is, however, very rarely the case in a big city like Calcutta and even in a restricted locality like a particular ward In the season 1947-48 Wards 5 and 20 served as the foci of infection and the disease subsequently spread mainly to the contiguous wards Hence the numbers of death or the death-rates obtained by calculation for the whole City on the hypothesis of uniformity of infection are an under-estimate but tend, in general, to show the growth of the disease

(4) The simplest assumption has been made that the relation between the number of deaths or the death-rates and the various seasonal factors are given by

$$y - {}^{*}\mathrm{y} = b_1(x_1 - \mathrm{x}_1) + b_2(x_2 - \mathrm{x}_2) + b_3(x_3 - \mathrm{x}_3) + $$

or $y - \mathrm{y} = \{b_1(x_1 - \mathrm{x}_1) + b_2(x_2 - \mathrm{x}_2) + b_3(x_3 - \mathrm{x}_3) + \quad \} p^n$

where

y = death-rate or the number of deaths four weeks or a month later, x_1, x_2, x_3, are the values of the seasonal factors, the figures under bar denoting the respective means, p = proportion of people unvaccinated, and n = a suitable integer

In the following investigation, Mean Temp and the Variation in Temp have been the two seasonal factors chosen on account of the high degree of correlation between these and the other relevant factors like Humidity etc and also on account of these two data being most easily available

* Roman letters indicate a bar (—) above the letter

TABLE 1

MONTHLY DATA FOR CALCUTTA (1944-45)

	(y)	(x_1)	(x_2)
April	6 00	83 7	19 3
May	2 60	89 1	15 7
June	1 90	88 9	16 5
July	1 00	84 4	10 2
August	0 44	84 2	10 6
September	0 52	85 5	12 1
October	0 83	81 3	13 7
November	3 30	74 5	23 5
December	6 90	70·5	24 6
January	6 50	65 9	23 6
February	6 40	71 8	25 8
March	2 62	83 0	23 4

y = Death rate due to small-pox in Calcutta in the succeeding month

x_1 = Mean temperature, averaged over the month in question

x_2 — Variation in temperature, averaged over the month

The predictive equation is

$$y - \mathrm{y} = b_1(x_1 - \mathrm{x}_1) + b_2(x_2 - \mathrm{x}_2),$$

where the values obtained are

$b_1 = -0\ 0901$ with s e, $= 0\ 0819$

$b_2 = \ \ 0\ 2787$ with s e, $= 0\ 1074$

Here b_1 is not significant while b_2 is significant on 5 per cent level The total correlation coefficient between y and x_1 is $-0\ 736$, that between y and x_2 is 0 838, both of which are strongly significant, but the partial correlation coefficient between y and x_1, eliminating x_2, is $-0\ 342$, not significant

It thus appears from the data given that an increase in the value of the Mean Temperature Variation in one month causes the death-rate in the subsequent month to increase but that an increase in the value of the Mean Temperature, though tending to pull down the death-rate, affects the rate mainly through its influence on the Temp Variation

TABLE 2

MONTHLY DATA FOR CALCUTTA (1947-48)

	(y)	(x_1)	(x_2)
March	1 464	81 9	21·6
April	0 603	89 4	19 9
May	0 318	88 7	16 6
June	0 159	87 3	13 1
July	0 084	84 9	10·2
August	0 063	84 6	10·1
September	0 039	85 2	11 1
October	0·102	82 0	13 9
November	*1 563	76 0	22 7
December		69 0	20 8

* (Provisional Figure)

Here

y = Deathrate (on an estimated population of 40 lacs) in the succeeding month

x_1 = Mean temperature averaged over the corresponding month

x_2 = Variation in temperature averaged over the corresponding month

The predictive equation is

$$y - \mathrm{y} = b_1(x_1 - \mathrm{x}_1) + b_2(x_2 - \mathrm{x}_2)$$

where the values are found to be

$b_1 = -0\ 0464$ with s e $= 0\ 0141$,
$b_2 = \ \ 0\ 0886$ with s e $= 0\ 0118$,

The total correlation coefficient between y and x_1 is $-0\ 633$ while that between y and x_2 is 0 934 The partial correlation coefficient, eliminating x_2, is $-0\ 874$, and that, eliminating x_1, is 0 974, all the values being highly significant

Substituting the values of the b's, the predictive equation becomes

$$\mathrm{y} = 3\ 002 - 0\ 0464x_1 + 0\ 0886x_2$$

Projecting the equation forward by one month we find the calculated number of deaths for January = 549, an under-estimate in view of the assumption (3)

Considering the exponential law and replacing y by e^y, we find that

$b_1 = -0\ 1555$ with s e $= 0\ 0372$ and
$b_2 = \ \ 0\ 1753$ with s e $= 0\ 0310$

The b's are both significantly different from zero

The regression equation becomes

$$e^y = 12\ 2685 - 0\ 1555x + 0\ 1753x$$

and the expected value for January is 548, a not sensible improvement over that obtained by the simpler hypothesis thesis of inverse linear, quadratic and cubic power of p The columns (x_1) and (x_2) give the Mean Temp and Temp Variation, averaged over the corresponding week-ending

The four predictive equations are taken to be

(1) $y - \mathrm{y} = b_1(x_1 - \mathrm{x}_1) + b_2(x_2 - \mathrm{x}_2)$
(2) $y' - \mathrm{y}' = b_1'(x_1 - \mathrm{x}_1) + b_2'(x_2 - \mathrm{x}_2)$
(3) $y'' - \mathrm{y}'' = b_1''(x_1 - \mathrm{x}_1) + b_2''(x_2 - \mathrm{x}_2)$
(4) $y''' - \mathrm{y}''' = b_1'''(x_1^3 - \mathrm{x}_1) + b_2'''(x_2 - \mathrm{x}_2)$

where $y - py' = p^2y'' = p^3y'''$

and the values obtained are

(1) $b_1 = -2\ 82$ with s e $= 1\ 26$, $b_2 = +3\ 04$ with s e $= 1\ 35$
(2) $b_1' = -3\ 22$ with s e $= 1\ 32$, $b_2' = +2\ 94$ with s e $= 1\ 42$
(3) $b_1'' = -3\ 55$ with s e $= 1\ 37$, $b_2'' = +2\ 86$ with s e $= 1\ 47$
(4) $b_1''' = -4\ 02$ with s e $= 1\ 43$, $b_2''' = +2\ 66$ with s e $= 1\ 54$

The corresponding predictive equations are

(1) $y = 193\ 0 - 2\ 82x_1 + 3\ 04x_2$, giving the value in Col (C)
(2) $y' = 227\ 0 - 3\ 22x_1 + 2\ 94x_2$, giving the values in Col (C')
(3) $y'' = 255\ 0 - 3\ 55x_1 + 2\ 86x_2$, giving the values in Col (C''))
(4) $y''' = 297\ 0 - 4\ 02x_1 + 2\ 66x_2$, giving the values in Col (C''')

TABLE 3

Week-endings	(p)	(y)	(y')	(y'')	(y''')	(x_1)	(x_2)	(C)	(C')	(C'')	(C''')
11 10-47	1 00	1	1	1	1	85 5	13 0	−6	−10	−11	−11
18-10-47	1 00	3	3	3	3	82 4	12 0	−3	−3	−3	−3
25-10-47	1 00	7	7	7	7	80 2	13 3	11	11	11	12
1 11-47	0 998	11	11	11	11	77 9	19 0	31	32	33	34
8-11-47	0 995	16	16	16	16	79 8	20 4	30	30	30	30
15-11 47	0 993	41	41	42	42	77 0	22 0	43	44	45	46
22 11-47	0 981	75	77	78	79	74 5	25 0	39	61	62	64
29 11-47	0 968	51	53	54	56	73 0	24 0	60	63	64	67
6-12-47	0 950	94	99	103	108	71 5	25 0	67	70	73	76
13 12-47	0 937	62	66	70	74	68 4	25 3	77	81	85	89
20 12-47	0 912	50	55	59	65	69 0	16 0	49	52	56	62
27-12-47	0 877	(59)				68 7	15 4	(46)	(*1)	(55)	(62)

This Table comprises the weekly mortality figures (due to small-pox) in the column headed y for Ward 5 only for the fourth week-ending after the corresponding week-ending stated in the initial column, the column headed p gives the proportion of people unprotected in Ward 5 in the corresponding week-ending (here the vaccination done by the Corporation staff only has been taken into account, as the ward distributions of the vaccination work done by others are not available) The column headed C gives the calculated number of deaths ignoring the effects of vaccination while the last three columns give the calculated number of deaths, eliminating the effects of vaccination, on the hypothesis of inverse linear, quadratic and cubic power of p

It appears, however, from the calculated and actual figures for the two week-endings 6/12/47 and 13/12/47 that the locally maximum value has been displaced by one week Hence in the following Table the mortality figures due to small-pox in Ward 5 were taken for the third week-ending after the period in the initial column.

This Table is a re-arrangement of the previous Table It may be added that the effect of squaring p is, for large values of p in the neighbourhood of unity, the same as assuming that the proportion of vaccinated people is double that taken in calculating p This accounts for, to a certain extent, the unknown proportion vaccinated by outside agencies.

TABLE 4

Week-ending	(p)	(y)	(y')	(y'')	(x_1)	(x_2)	(C)	(C′)	(C″)
8-11-47	0.995	11	11	11	79.8	20.4	4	Neg	Neg
15-11-47	0.993	16	16	16	77.0	22.0	25	Neg	19
22-11-47	0.981	41	42	43	74.5	25.0	49	49	45
29-11-47	0.968	75	77	80	73.0	24.0	58	56	53
6-12-47	0.950	51	54	56	71.5	25.0	67	69	66
13-12-47	0.937	94	100	106	68.4	25.3	86	91	89
20-12-47	0.912	62	67	73	69.0	16.0	57	62	61
27-12-47	0.877	50	56	62	68.7	15.4	57	62	62
3-1-48	0.850	(63)			67.8	23.7	(85)		(90)
10-1-48	0.837				68.8	21.6			

Taking the usual form of the predictive equation we find that

(1) $b_1 = -6.054$ with s e $= 1.302$, $b_2 = +2.776$ with s e $= 1.344$

(2) $b_1' = -6.611$ with s e $= 1.321$, $b_2' = +2.677$ with s e $= 1.363$

(3) $b_1'' = -7.174$ with s e $= 1.916$, $b_2'' = +2.552$ with s e $= 1.978$

The predictive equations take the forms

(1) $y = 430.13 - 6.054x_1 + 2.776x_2$, giving the values in Col (C)

(2) $y' = 475.0 - 6.611x_1 + 2.677x_2$, giving the values in Col (C′)

(3) $y'' = 516.0 - 7.174x_1 + 2.522x_2$, giving the values in Col (C″)

based on which the calculated values in the last three columns have been found

The conclusions arrived at are

(1) The fit between calculation and observation taking vaccination into account is not better than that ignoring the effects of vaccination, so far as the course of the disease has been studied here

(2) Mean temperature has a negative influence, and Variation in temp has a positive influence, on the death-rate three weeks later A glance at the above Table shows that the Temp Variation has had a big rise since week-ending 3-1-48 and this has actually caused an increase in the number of small-pox deaths in almost every affected ward during the week-ending 24-1-48, three weeks later

These conclusions are, however, based on the meteorological conditions prevailing in Calcutta If the temperature or the temperature variation goes beyond the range we have studied here the conclusions may or may not be valid

Notes and News

INDIAN COUNCIL OF AGRICULTURAL RESEARCH

THE Annual Report of the Indian Council of Agricultural Research for 1946-47, which has just been published, contains an account of the activities of the Council in agricultural research during the year.

As regards rice it was observed that in Kashmir, Russian, Chinese and American varieties of rice fared well and some of the newly introduced Chinese varieties gave heavy yields In Madras some strains were found fairly resistant to the blast and foot-rot diseases

Research work on brown, yellow and black rust, which has been going on for some considerable period now, was continued There is an indication that persistence of rust from year to year is due to the over-summering of rust on volunteer and early-sown wheat crop in the hill areas In the scheme for breeding of rust-resistant varieties of wheat at Simla, the work of hybridization between the best indigenous wheat and variety known to be rust-resistant has been completed

A scheme for testing the milling and baking quality and biochemical properties of Indian wheats had been in operation in the Punjab It was observed

that the quality score of some samples were quite high. Investigations on the vitamin B content of *ata* from wheat ground in different ways, showed that the losses were the least with hand *chakki*.

There are 26 horticultural and fruit research schemes in operation of which 10 are on Citrus.

At present five schemes on potato research are in operation.

Investigations show that detached potato sprouts can be successfully utilised for raising potato crops when grown whole or as cuttings. Preliminary trials have indicated that the yield obtained from sproutlings compare favourably with those raised from whole tubers.

With regard to storing of cereal grains it has been established that grains mixed with powdered *Neem* leaves suffer the least damage. Mercury dispersion powder can also be effectively used as a preservative.

The research scheme on artificial insemination, which has concluded at the Indian Veterinary Research Institute, shows that the production and preservation of semen is practicable under Indian conditions and that the buffalo is good subject for insemination. The prejudice against artificial insemination in this country is not as great as was at one time believed.

Experiments show that improved feeding markedly improves egg production and that pure breeds or graded-up stocks of fowls do not produce more eggs than the *desi* variety unless they are adequately fed.

Livestock fed on alkali-treated straw at Montgomery and Rampur grew 17 per cent and 195 per cent more quickly than those fed on untreated straw. The feeding of the treated straw to milking cows at Rampur resulted in an increase in milk yield by 11 per cent.

It has been reported that the failure to process milk, the storage of butter for days before melting and the over-heating of butter are among the chief reasons for the reduced storage life of *ghee* produced in villages.

MICROSEISMS AND DISTURBED WEATHER—NEW AID TO FORECAST WEATHER

During World War II, when radio silence was enforced on ships which formed the only source of weather observation at sea, Indian meteorologists were considerably handicapped in forecasting weather.

It then struck one of the meteorologists that possibly some aid in forecasting storms and cyclones and squalls over the sea could be had from microseisms recorded by a sensitive seismograph—the instrument used for detecting earthquakes.

It had been known for a long time that a sensitive seismograph revealed feeble ground movements from time to time when the weather happened to be disturbed. These movements which are known as 'microseisms' are independent of earthquakes and manifests themselves in the form of wavy curves of small amplitudes and frequencies in the seismograms.

An examination of the seismograms in the Alipore Meteorological Office containing records of microseisms followed. It was discovered that these records provided valuable information in general about weather disturbances and gave indication of disturbed weather well out at sea which was not obtainable from the restricted weather charts of the War days.

These investigations covering the hourly tabulations of 8 years' records of Alipore and some of the records of Bombay, Kodaikanal and Agra, which have been published by India Meteorological Department, reveal that microseisms are of three kinds. The first, which consists of uniform vibrations, is caused by monsoon in the Bay of Bengal and also appears in the initial stages of a disturbance or with a far-away storm over sea or sometimes when a disturbance is filling up. The storm-type, which consists of uneven groupings of small amplitudes is caused by depressions and storms in the Bay of Bengal and sometimes also in the Arabian Sea. The third—the gusty wind type—consists of a series of bulges.

The authors conclude that microseisms provide advance information about intensification and weakening of monsoon in the Bay of Bengal and Arabian Sea, the development and movement of depressions and cyclones over sea, the formation of land depressions and cyclones and the occurrence of gusty winds, squalls and thundersqualls. (*Scientific Notes, India Meteorological Department*, Vol *10*, No 120, 1948)

FOG AT CALCUTTA

In a recent publication of the India Meteorological Department, (*Scientific Notes*, Vol *10*, No 124, 1948) observations of fog at Alipur, Dum Dum and Bally during January 1938 to December 1940 have been analysed and the frequencies of foggy day computed. The monthly frequencies of foggy days are less at Dum Dum than at Alipur and Bally particularly in January and February. The frequency is maximum in January at Alipur and Bally and more or less uniform during December to March at Dum Dum.

The annual frequency of 'advection' type of fog is less than that of "radiation" type, but the advec-

tion fog is more frequent than radiation fog in February From the frequency distribution of total number of occasions of fog observed at Alipur, Dum Dum and Bally in accordance with the times of onset, it is concluded that the most favourable time for onset of fog is near about the time of sunrise It is often observed that a day-break fog on lower ground gets thinner with a gradual intensification of fog in the upper layers With sunrise there is often a sudden thickening of fog at the lower layers extending up to high levels It is quite possible that sun light produces more hygroscopic nuclei and thus creates a favourable atmosphere for enhanced condensation With the advance of the day, insolation takes the upper hand and fog at all the levels commences to disperse Fog seldom persists for more than 3 hours, January and February being the months of maximum duration of fog The normal value of surface wind velocity at Alipur during early hours of morning in cold season when fog is most prevalent varies from 1 5 to 3 m p h , but on most of the foggy days the wind velocity does not exceed 1 m p h before the onset of fog On most of the occasions before commencement of advection fog southerly wind prevails in lower levels in early mornings although there are no southerlies in the previous afternoons The development of moisture laden southerlies in early mornings while changing the composition of air mass raises its dew point and creates a favourable atmosphere for condensation The analysis of wind cloud and temperature data before the onset of fog indicates the conditions which are most favourable for the formation of fog The thermograph records of the station for the earlier part of a night helps in the prediction of fog during the next morning

CONTINUOUS FERTILISER

SPECIALISTS in the U S A are developing a compound of urea and formaldehyde, "urea-form", of which the solubility in the soil can be controlled Urea-form furnishes nitrogen to plants gradually and over long periods of time—an advantage not common to present commercial fertilisers In the form of a white powder, it has a capacity for taking up water from the atmosphere without caking or impairing its free-flowing qualities When mixed with other fertilisers, it is stated to act as a "conditioner" by checking the caking of such a mixture Free flow is specially important in fertilisers applied by modern machines which leave a band of fertiliser in the soil a little below and to the sides of the row where the seeds are planted Tests have also shown that combination of urea-form with quick-acting nitrogen fertiliser furnishes a continuing nitrogen supply throughout the growing season, thus increasing total yield and spreading the plants' growth over a longer period (*The Chemical Age*, September 18, 1948)

NEW BERYLLIUM ALLOYS

IN five American patent applications (Nos 6042-46) special claims are made in the preparation of beryllium alloys Patent No 6042 relates mainly to magnetic steels, for which it is said the chromium steels have not proved entirely satisfactory In the present invention a small amount of beryllium is included to impart the exceptional magnetic and physical properties desired in magnets and other articles of manufactured steel, including greater hardness and strength, and better fluidity when molten Carbon content is from 0 1-1 25 per cent, chromium 1-8 per cent, and beryllium from 0 03-0 7 per cent The alloy may also contain from 0 1-0 5 per cent silicon and manganese, with the usual impurities phosphorus and sulphur Patent No 6043 claims improvements in beryllium-cobalt alloy steels and articles made from them, especially tool steels, die steels, and structural steel

In the present series of alloy steels the principal constituents are 0 5-14 per cent chromium, 0 1-1 per cent cobalt, 0 05-0 5 per cent beryllium, and 0 25-2 5 per cent copper They are capable of being hardened up to a Brinell hardness of 600, by suitable heat treatment Carbon content is 0 1-3 per cent Heat treatments include heating up to 1450-1550°F, followed by air cooling , much lower temperatures than usual are claimed The composition may also include molybdenum

Patent No 6044 claims to afford improvements in chromium-free air-hardened aloy steels and articles made from them, either cast or wrought, especially tools, dies, etc An example is the Mushet type alloy, containing 0 03-0 3 per cent beryllium, 0 25-2 5 per cent copper, 0 5-2 5 per cent silicon, 0 5-2 5 per cent manganese, and 0 75-3 25 per cent molybdenum Brinell hardness ranges from 600 to 653, and heating temperatures are again low

Patent No 6045 is concerned with chromium-beryllium alloy steels and products The proposed uses include castings and rolling mill products , and particularly castings for which the usual chromium and stainless steels are not altogether suitable, owing among other things to unsatisfactory fluidity Intricate and complicated castings are possible Composition is 0 5-14 per cent chromium, 0 5-4 5 per cent silicon, relatively small amounts of beryllium, 0 5-6 per cent copper, 0 05-2 per cent carbon, and upto 0 5 per cent manganese These alloys are characterised by high strength, fluidity, and good ductility when subjected to loads suddenly applied Covering a similar field, Patent No 6046 is concerned with beryllium-copper alloy steels (*The Chemical Age*, September 4, 1948)

THE 200-INCH TELESCOPE

The 200-inch telescope constructed in the Palomar Mountain has been named the Hale reflector after Dr George Ellery Hale, whose vision and foresight made its construction possible One of the disadvantages of the yoke mounting of the conventional type is that the telescope cannot point to the north celestial pole In the case of the 100-inch instrument, the maximum observable northerly declination is in the neighbourhood of 65°, so there is a large inaccessible area around the north pole Within that region are many stars that belong to the fundamental standard-magnitude sequence The horseshoe mounting of the 200-inch permits it to reach these circumpolar objects, enabling direct comparison of magnitudes observed there with those of stars and galaxies in other parts of the sky This is especially important where observations of some of the galaxies near the north pole of the sky, such as at M81 and M82, are concerned

At present, the primary mirror and Cassegrainian mirror are installed and in operation, but the auxiliary mirrors of the coude system are in the process of installation Altogether there are seven mirrors in the giant telescope (1) The 200-inch mirror, a paraboloid having a focus of 55½ feet or 666 inches (2) The Cassegrain convex, 41 inches in diameter, hyperboloidal with an eccentricity of about 1 52, providing a focal length of 263⅔ feet, or 3,200 inches (3) Two coude hyperboloids, 36 and 32 inches in diameter, each of eccentricity 1 25 and producing a focal length of 500 feet, or 6,000 inches (4) A coude diagonal plane mirror, 36 by 53 inches, to reflect the light along the polar axis to the coude spectrograph in a constant-temperature room directly south of the telescope (5) Two auxiliary plane mirrors, 28 and 20 inches in diameter, for use with the coude diagonal when objects north of 50° declination are observed

All of these mirrors are made of pyrex glass, and all except the two small flats are of the ribbed-back construction with internal supports (*Sky and Telescope*, September, 1948)

RESIN FOR ION EXCHANGE PROCESSES

Four additions to the Amberlite family of ion exchange resins have been announced by the Resinous Products and Chemical Co The efficient production of vitamins, alkaloids, and amino acids , the one-step removal of all ions from solution , and the reversal of conventional deionization are part of the flexible versatility that the new absorbents are said to bring to the solution of water-conditioning, food-treating, pharmaceutical, and other processing problems Milk, protein hydrolyzates, blood, sugar-materials sensitive to fluctuations in pH—now may be processed readily by means of "mixed-bed" exchange

Behaving like solid caustic with only its hydroxyl ions in solution, Amberlite IRA—400 will absorb negatively charged ions from acidic, neutral, and even mildly alkaline solutions at speeds unapproached by other anion exchangers

Amberlite IRC—50 is a cation exchanger which derives its exchange activity from weakly-acidic carboxylic groups It is the first white synthetic resin exchanger available to the pharmaceutical cosmetic, and food processing fields The extreme selectivity of the new absorbent permits the effective separation and recovery of such chemically similar materials as amino acids Treatment of Amberlite IRC-50 with an appropriate buffer converts the resin to a combined salt-acid form so that cation exchange occurs at a controlled pH

Where high concentrations of ions must be adsorbed, or where extremely aggressive influent solutions and high temperatures must be met, Amberlite IR-120 will be used The very high capacity (28 kilograms) of this bead-form cation exchanger suggests its adaptation to the recovery of valuable cations from plating, rayon-spinning, and photographic waste solutions

Main advantages of Amberlite IR-105, a high capacity exchanger in bead-form include (1) a smooth spherical shape, (2) freedom from odor, taste, and colourthrow, (3) highly uniform particle size, (4) higher density, (5) rugged physical properties, and (6) high exchange capacity obtained at efficient regeneration levels Its unusual chemical stability and high capacity are of special interest in applications such as the softening, dealkalization, and deionization of water (*Chemical and Engineering News*, July 12, 1948)

AUSTRALIA S RIVER PROJECT

It has been announced recently by the Queensland Government that a dam will be built on the Burdekin River which lies 780 miles north of Brisbane This dam will be able to store nearly four times the amount of water held by the Hume Reservoir, now the biggest in Australia The Government wants the Burdekin dam for the generation of hydro-electricity as well as irrigation It proposes a dam wall 130 ft high, 99 miles upstream, just below where the Sutter River joins the Burdekin Such a dam will hold back the waters of the Burdekin and its tributaries for 100 miles. The ponded area will be about 145 sq miles and the capacity something like 5,500,000 acre ft This will cost at least £12,000,000 The great dam will catch the water from 50,000 sq miles. On the irrigation side, this

water will bring into a high state of production, about 400,000 acres of uncultivated land.

The new Stirling Dam in the South West of the State takes second place Its capacity of 44,000 acre-ft of water is exceeded by the 76,000 acre-ft of the Canning Dam, some 30 miles away to the north On the upstream side of the stirling 12,000,000,000 to 13,000,000,000 gallons of water fill a lake of 1,000 acres Work began on the stirling Dam in 1937 It stopped during the war, and was taken up again in February, 1946 The dam has been built in a steep-sided valley, through which the Harvey River flows The completion of the Stirling Dam has increased the irrigated area in its particular section of Swanland to 36,000 acres Latest irrigation plans of the Western Australian State Government envisage the spending of £14,000,000 on water storage works to feed the wheat lands mainly in the South West

One of Australia's most spectacular engineering projects is the construction of the huge Eildon Weir dam in the Goulburn Valley of the State of Victoria The work is expected to be started this year To rank in size with some of the world's largest earth and rock dams, it will be raised to 244 ft and will be 2960 ft long It will increase the capacity of the existing weir from 306,000 acre ft to 2,350,000 acre ft In the present Goulburn Valley system 345,000 acres are under irrigation out of a total of 708,000 acres of irrigation in the State (*Water and Water Engineering*, September, 1948)

ATOMIC ENERGY NEWS

According to the *Bulletin of Atomic Scientists*, the Atomic Energy Commission of U S A has a budget of 646 million dollars (nearly 160 million pounds), the budget of the British Atomic Energy Committee has not been revealed, but it is guessed to be about 20 to 25 million pounds, and that of the French Atomic Energy Commission is given out to be 1200 million francs, roughly 2½ million pounds Thus while the U S A spends one dollar on Atomic Research, U K spends 10 cents, and France only 1 cent

What results can France hope to achieve with this one per cent of the American effort? Asks Dr Low Kowarski, Technical Director of the French Atomic Energy Commission Kowarski himself supplied the reply He says that it would be folly to divert any fraction of these limited resources towards military applications, and France has no intention to do so

But what can she expect to achieve even for peace time applications? Kowarski says

"Our attention is focussed on that *not-too-remote future* (perhaps in a generation or so) when atomic energy will be of considerable economic importance When this time comes, every country which intends to go on playing a *not-too-insignificant* role on the world stage should have their own specialists in the atomic field"

The Atomic Energy Commissions and Committees spend a good fraction of their budget on fundamental research The following basic principles have been adopted by the U S A Atomic Energy Commission

(1) All possible encouragement must be given to the development of a fundamental theory of atomic nuclei, and

(2) The possibility of waste of capital, due to premature obsolescence caused by revolutionary advance in the science of Nuclear Physics, is reduced once such a theory exists

What percentage of the budget of Atomic Energy Commission is spent on fundamental research? According to our information from 20 to 25 per cent i e, about one hundred twenty million dollars Fundamental research is carried on at the National Laboratories of Argonne, near Chicago, at Brookhaven, N I, at Oakridge, Tennessee, and is supported at many university centres

BIBLIOGRAPHY ON INDIAN ZOOLOGY

The first instalment of 56 papers being the half-yearly (January-June, 1948) list of zoological papers by workers in India and adjoining countries and published in various journals appears in the current issue of the *Proceedings of the Zoological Society of Bengal*, September, 1948, p 113 The list though incomplete will be of immense benefit to workers all over the world and we trust that with the co-operation of all workers of South-East Asia, a more comprehensive list will be issued hereafter It is needless to emphasize the importance and necessity for such compilation work, that could help in bringing about international co-operation amongst zoologists of the world

The present issue of the *Proceedings* of the Zoological Society of Bengal has well maintained the standard of the previous one (see SCIENCE AND CULTURE, *13*, p 496, 1948) There are seven original papers by workers in Calcutta and other parts of India and the subjects cover a wide range, *e g*, sex hormones, insect parasites, nematodes, cytology, embryology, etc

ANNOUNCEMENTS

Sir C V Raman has been appointed the first National Research Professor in recognition of his unique services in the cause of Science The Professorship is created by the Government of India under the Department of Scientific Research

The Zoological Survey of India that was transferred to Banaras in 1942 from its original headquarters at the Indian Museum as a war measure is now being re-transferred to Calcutta and from January 1, 1949, the address of the Survey will be Jabakusum House, 34, Chittaranjan Avenue, Calcutta The Library of the Survey will however resume its work at the Indian Museum, Calcutta, from March 1, 1949, and will remain closed to outsiders from November 1, 1948 to February 28, 1949 (See *Science and Culture*, 4, 544, 1946)

DR J N MUKHERJEE, Director, Indian Agricultural Research Institute, has been invited to be one of the Vice-Presidents of the Fourth International Congress of Soil ~~Sentence~~ Science to be held at Amsterdam in 1950

A scientific conference on the conservation and utilization of Resources convened by the Economic and Social Council of the United Nations will be held in U S A in May-June, 1949 Dr J N Mukherjee, Director, Indian Agricultural Research Institute, New Delhi, has been invited to prepare a paper on 'Tropical Climates' for the section devoted to the Improvement of Soil productivity

ERRATA

In October 1948 issue, p 137, Column 2, *for* Somatic chromosome number 22+21 *read* 22+2f on p 139, Column 1 insert the following "showing different chromosome numbers like $2n=16$", between lines 4 and 5

BOOK REVIEWS

Prospects and Potentialities of Pakistan —By Prof Maneck B Pithawalla, D Sc, F G S, Victoria Road, Karachi 1947 Pp 41 with two tables and a map Price not mentioned

The book under review is a reprint of articles published in the *Daily Gazette* 'with a view to create some interest in the geographical aspects of the new dominion of Pakistan' (Preface) The name is hardly justified, inasmuch as very scanty attention has been paid to Eastern Pakistan, which the author considers to be a 'minor eastern zone' (Page 1, Para 3) of Pakistan Even a map of that populous and important part of Pakistan is lacking Although the survey of mineral resources and specially petroleum is adequate, no separate or comparable discussion has been included on the rich agricultural resources of Pakistan, by exporting the surplus of which to India Union she can expect to meet up her demands of manufactured goods His survey of mineral wealth convinces the author that 'prospects of mineral resources of the dominion of Pakistan are on the whole poor' (Page 12) "And if the India Union" continues the author in another place, "has all the best minerals, heavy and precious metals, etc it can easily supply to the sister State excellent manufactured goods of cotton, jute, etc, in return" (Page 19) for the surplus agricultural stock

The book opens with a search for the capital of Pakistan, where the author advocates the case of Rawalpindi as being centrally (?) situated and having historical tradition and industrial prospects He specially discards the claims of Karachi, which has acute shortage of water and where the saturation point of population absorption has almost been reached Dr Pithawalla suggests redistribution of provincial boundaries of Western Pakistan and creation of three provinces only there, *viz*, Upper and Lower Indus Basins and Baluchistan

The two tables giving information regarding agricultural and mineral wealth are valuable, but one deplores the author's branding the secular state of India as 'Hindustan' and present Delhi as the 'imperial capital' (Page 1, Para 1)

P K S

The Art of the Film. —By Ernest Lindgren Published by George Allen & Unwin Ltd, London Pp 242 with index Price 16*sh*

Mr Lindgren has modestly set out in the preface of the book that his main objective in presenting this book has been to stimulate criticism of a film in order to make it a means of social utility The material has been largely drawn from lectures he has given since 1938 and specially in 1944, 1945, and 1946 He has arranged the contents into two parts The first part is an introduction giving an insight into the organisation of film production and in the second part the author initiates the reader in the technique of making a film, namely, acting, music, camera, sound and the most important, editing. He has been successful in impressing the qualities of editing which make a film an art for the film-goers and a success for the pro-

ducer All throughout the book Mr Lindgren recedes in the background and the reader is transported to the different departments of the film studio His treatment of the various technical aspects of production has fulfilled his expectation of rendering assistance to film technicians by helping to stimulate public appreciation of the elements that raise the film to the rank of art As a matter of fact, a film has generally been taken to be an entertainment just for the period one is inside a cinema hall But film as a motive force in social progress is being acknowledged and Mr Lindgren as an enthusiastic officer of the British Film Institute has done a good service both for the people and the film-makers

Mr Lindgren has a beautiful literary flare and after finishing the book the reader will be completely satisfied as having got what he wanted to know from the title of the book Literature on film has grown since film came into society as an object of curiosity a little over half a century ago and Mr Lindgren's book may mark the beginning of an educative, as distinct from pedantic, type of book in order that ordinary people may grasp film as a social force and appreciate it as a means of international understanding It is interesting to report that the Unesco has under study the use of film as one of the means of mass communication for bringing together all the peoples of the world The first international festival of documentary films, arranged in co-operation with Unesco, was held in Edinburgh in August and September last year

There are 32 pages of excellent halftone plates and the appendices include a specimen film script, a select bibliography and a glossary of over 500 technical terms The price of the book seems to be discouraging to the people whom the author wishes to approach

P C B

College Zoology—By late Professor Robert W Hegner, Ph D , Sc D , Fifth Edition, Pp xvii + 817 (New York Macmillan & Co Ltd , 1942), 25*s* net

The 6th reprint of the Fifth Edition (1942) of *College Zoology* has appeared in 1948 after the death of Professor Hegner The usefulness of the work has been amply demonstrated by the quick succession of reprints of the fifth edition 'Type study' as a means of knowing a particular group of animal has been adopted throughout the text thus rendering the book, as any other foreign book of this type on Zoology, to be of somewhat limited use to the Indian students, who use entirely different animals as types for their practical classes The portions dealing with general Zoology (chapters xxxi-xxxviii) are lucid, well illustrated and are universally useful We specially recommend to our students to make constant use of the 'glossary' which gives exact definitions of hundreds of very useful zoological terms

S P R C

A Class-Book of Botany (for Intermediate and Medical students)—By A C Dutta, M Sc Pp XIV + 475 with 583 text figures Published by Geoffrey Cumberlege, Oxford University Press, Calcutta Seventh Edition (Revised and enlarged), 1948 Price Rs 8/8/-

This book is already well known to students of different Universities in India and we welcome its appearance in a revised edition Prof Dutta from his long experience as a teacher has been able to incorporate in this book in a simple way up-to-date knowledge gathered in different branches of Botany The appearance of this present edition is amply justified because it shows a marked improvement over the previous one published three years ago This is specially noticeable in Part VIII (Evolution and Genetics), besides the addition of new and re-drawn diagrams and explanatory foot notes throughout the text The glossary of Indian names of plants is very useful to students It would have been more impressive to students if the life histories of plants, especially the lower plants were explained with common Indian species as examples and mentioning their geographical distribution The scope of the study of Botany (even if it is Pure Botany—*vide* p XI) with reference to Agriculture, Horticulture, Forestry, Paleobotany and economic uses of plants and plant products has been neglected in the text Further, the omission of the following in a modern text book is very glaring Vitamins, Hormones, Vernalization, Chromosome theory of sex determination, Limiting factors, etc In spite of these omissions that may be attended to in a subsequent edition, the edition under review is a mine of botanical information and is a very suitable text book for intermediate students of Botany and Biology, who can with full benefit depend on it for their courses of study

P N B

International Rules of Botanical Nomenclature.—Compiled by W H Camp, H W Rickett and C A Weatherby Published by the Chronica Botanica Co , Waltham, Mass U S A Indian selling agents Messrs Macmillan & Co Ltd , Calcutta, Bombay and Madras Second Printing, cloth, p 120 Price $3 50

Since the publication of the last official edition of the International Rules of Botanical Nomenclature

(Gustav Fischer, Jena, 1935), a number of very useful papers have been published Unfortunately, neither the rules nor these papers were available for a long time, and with a growing interest in botanical nomenclature, the demand for these books has continually increased The American Society of Plant taxonomists, and Drs Camp, Rickett and Weatherby in particular, are to be congratulated for bringing out a very useful compilation of the 1935 rules as adopted and revised by the International Botanical Congress at Amsterdam, together with additional list of conserved and rejected names, and an admirable index Their original compilation was published in *Brittonia 6* (1947), but, as was to be expected, all the copies were soon exhausted Botanists are beginning to realise that for any taxonomical work, the rules of botanical nomenclature are to be consulted very frequently Even for the teaching of taxonomy in the Universities, a general knowledge of the rules is necessary No regional conference on Botanical Nomenclature is possible without several copies of the rules All these, have necessarily increased the demand for this book, and we are glad to note that Messrs *Chronica Botanica Co* have been able to reprint this recent work by Camp *et al* which is now once again available

Botanists have been often blamed for changing well-known names but a careful study of the rules of nomenclature would reveal that these changes are often imperative for the purpose of precision For example, the name *Magnolia sphenocarpa* Roxb, was used purely by mistake (*lapsus calami*) in the Flora of British India *1*, 41 (1872) for *Magnolia pterocarpa* Roxb So, persistence in the use of the former name (cf Fl Assam *1*, 141, 1934) would only create confusion, and the latter name has to be adopted Similarly, the genus *Unona* as described and understood by the younger *Linnaeus*, is confined to South America and it has been clearly established by Safford (*Bull Torr Bot Club 39*, 501, 1912) that the Asiatic plants known under this name are very distinct and different All these plants are now to be known as *Desmos*, and this generic name is of course to be adopted for the Asiatic species The well-known *Edelweiss* (*Leontopodium alpinum* Cass) of European mountains has been known for a long time to extend to the Himalayas (Fl Br Ind *3*, 279, 1881) But the Himalayan plant, although belonging to the same genus, is quite different from the European species It will therefore be wrong to call the Himalayan plant any more by the name *Leontopodium alpinum* Cass These are simple and easy instances where a change of name is obviously necessary There are other more difficult cases too, which could be settled, by a study of nomenclatural rules

The change of names are made only with the good intentions to stabilise names, in conformity with taxonomical and nomenclatural requirements Stearn says "Vexations though changes in the nomenclature of familiar plants are, there usually exist good grounds for such changes, and when they are well founded, their ultimate acceptance is merely a matter of time " (Lily Year Book 1947, 101)

I fully endorse the above statement and strongly recommend the copy of the botanical rules to all botanical institutes in South East Asia, *i e*, India, Pakistan, Burma, Ceylon, Siam, Malaya, and Indo-China The book is most timely in connection with the preparations for the forthcoming Seventh International Botanical Congress to be held at Stockholm in 1950

D C

LETTERS TO THE EDITOR

[*The Editors are not responsible for the views expressed in the letters*]

X RAY STRUCTURE OF SHELLAC

THE X-ray diffraction study of shellac, like all physical properties of the same, has been done in passing along with other amorphous substances while verifying some general characteristics of liquid diffraction Clarke[1] appears to have made the study of X-ray diffraction pattern of shellac for the first time He has classed shellac as an amorphous substance but has not recorded any measurement Von Naray-Szabo[2] on the other hand, obtained more or less five distinct rings, some of which are sharp and some diffuse and has classed shellac as a crystalline resin Krishnamurty[3] again, obtained two distinct rings at 11Å and 4Å respectively, and classed it as an amorphous substance But these authors have not mentioned what they used in their study Shellac is not a single chemical entity It consists of hard resin, soft resin and wax The wax again constitutes a number of lower and higher aliphatic alcohols and acids Advantageous results will only be obtained if the constituents are separated and examined separately

The X-ray diffraction measurements (powder-photographs) have been done on the hard resin after repeated extraction of soft resin with ether Two diffuse rings have been obtained at 4 21Å and 10Å The 10Å ring was very intense and diffuse, similar to liquid cybotactic This is most probably due to miceller aggregation of hard resin molecules The outer ring at 4 21Å is sharper but much less intense This ring is difficult to account for Most probably this may be attributed to the presence of a carbon chain of more than four carbon atoms as has been verified by Katz[4] for a number of organic compounds The assumption is also not very improbable from the structural point of view Shellac is known to contain aleuritic acid (trihydroxy palmitic acid) to the extent of 40-50 per cent of the weight of shellac Thus it may be assumed that at least a portion of the aleuritic acid chain is present as such in the hard resin molecule

Thanks are due to Dr P K Bose, Director, Indian Lac Research Institute, Namkum, for his keen interest in the present work

Indian Lac Research Institute, Namkum, Ranchi
SADHAN BASU
3-7-1948

1 Clarke, *Ind Eng Chem*, *18*, 1131, 1926
2 Von Naray-Szabo, *Bioch Zt*, *185*, 86, 1927
3 Krishnamurty, *Ind J Phys*, *4*, 99, 1929
4 Katz, Phenomenon of Polymerisation and Polycondensation, Faraday Society, p. 84

JAMAN (BLACK BERRY) SEED AS A CATTLE FEED

IN India the shortage of concentrates is much more acute than that of roughages To meet this shortage, the use of mango seed kernel[1] and entrails[2] which are largely thrown away as waste was suggested The mango seed kernel could be satisfactorily used as a partial substitute for grains and oil cakes in cattle rations, making available about 70 million lbs of digestible protein and 760 million lbs of starch equivalent, and the entrails is a rich source of protein for cattle, making available about 47 4 million lbs of excellent protein material

Analysis of *jaman* seed (Table I) show that the seed is fairly rich in crude protein and calcium and may be utilized as a cattlefeed

TABLE I

CHEMICAL COMPOSITION OF *Jaman* SEED

	Crude protein	Ether extract	Crude fibre	Nitrogen free extract	Ash	Calcium (Ca)	Phosphorus (P)
Jaman seed	8 50	1 18	16 90	51 70	21 72	0 41	0 17

Adult Kumaoni bullocks were fed on wheat straw and a concentrate mixture composed of rape cake and *jaman* seed in equal proportions The animals relished the concentrate and consumed the entire quantity offered to them Two weeks later the proportion of *jaman* seed in the concentrate mixture was raised to 75 per cent The feeding observations extended over a period of 30 weeks and it was found that the adult animals which ordinarily maintained weight on the scheduled ration of this Institute, gained on an average about 32 lbs and put on a fine bloom and presented a healthy appearance

A digestibility trial conducted on three adult Kumaoni bullocks, after about five weeks feeding on wheat straw and a concentrate mixture consisting of rape cake and *jaman* seed in the proportion of 1 3, gave a positive balance for nitrogen, calcium and phosphorus, that of the former being fairly high

The digestibility co-efficients of the various constituents of *jaman* seed and the biological value of the protein (Table II) were fairly satisfactory.

TALBE II

DIGESTIBILITY COEFFICIENTS AND BIOLOGICAL VALUE OF *Jaman* SEED

	Digestibility coefficients						
	Organic matter	Crude protein	Ether extract	Crude fibre	Nitrogen free extract	Total carbo-hydrates	Biological value
Jaman seed	41 1	68 5	72 2	42 5	54 4	60 3	84 3

The digestible protein, starch equivalent and total digestible nutrients per 100 lbs of *jaman* seed were 5 8, 45 1 and 45 5 respectively

These values give *Jaman* seed a place in the list of concentrates of proved value and it can be used to replace oil cakes to the extent of about 75 per cent The keeping quality of these seeds seems to be satisfactory as no deterioration was observed after twelve months storage

It has been found that one tree yields about two to four maunds of seeds annually and since there are millions of *jaman* trees growing on the plains all over India, it is believed, that these observations would make available, from a hitherto unutilized source, millions of maunds of protein rich food for live-stock

Details of this investigation will be published elsewhere

N D KEHAR
K SAHAI

Animal Nutrition Section,
Indian Veterinary Research Institute,
Izatnagar, 25-8-1948

[1] Kehar, N D and Chanda, E , *Ind J Vet Sci Ani Husb* , *15*, 280, 1945
[2] Kehar N D and Chanda, R , *Ind J Vet Sci and Ani Husb* (*In press*), 1947

DATURA METEL L AND *DATURA FASTUOSA* L

I

My attention has been drawn to the note published on this subject [1] Safford as long ago as 1921 dealt with this very point [2] Not only does Safford accept the name *Datura metal* L for the variable Indian plant, but also he reduces *Datura fastuosa* L to the rank of synonym under the name of the former His reasons for this have been admirably set out and should be found generally acceptable He also refers to the fact that Clarke,[4] has completely confused the identity of *Datura metel* L , and that this confusion was largely due to the plate No 1440 in the *Botanical Magazine* In fact, Safford's work of twenty-seven years ago, led inevitably to the same conclusions that have been reached by Narayanaswami in 1948 ! The latter's paper, therefore, does not give us any additional information on the subject

Although Linnaeus distinguished *Datura metel* L and *Datura fastuosa* L in his earlier works, he abandoned this distinction later (*Syst Nat* , *2*, 932, 1759) when he recognized Rumphius's plate (*Herb Ambolm* , *5*, tab 87, 1750) as representing only *Datura metel* L As is well known, this plate shows both single and double flowered forms The characters of tubercles or prickles on the fruit, white or purple colour, or single or multiple flowers, do not hold good for any satisfactory distinction Safford says

> "These differences are nominal and one has only to examine the fruits of various forms of this East Indian *Dhatura* to be convinced of the variability of their tubercles or prickles That the white and purple forms of the single or double flowered plants should all be referred to one species by Linnaeus, is justified by the best modern authorities on East Indian botany"

Quite contrary to this opinion, Narayanaswami has considered it necessary to make *D fastuosa* L , a variety of *D metel* L , and has given the characters of the prickles and colour of the corolla to distinguish it That this variety is superfluous, and untenable is clear, fortunately, by Narayanaswami's own admission, as he says (*l c*) "These varietal characters should not be considered enough either for specific or varietal separation "

Burkill in his *Dict Econ Prod Mal Pen* , 1, 768, 1935, has adopted the name *Datura metal* L and has referred to Safford's paper It appears that this book was overlooked Finally, if the sole purpose of Narayanaswami's note is to create the unstable variety out of *D fastuosa* L , surely, this has also failed, as "*D metel* var *fastuosa*" is already available in the Annual Report of Smithsonian Institution 1920, Pp 547-548, 1922

D CHATTERJEE

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23-7-1948

[1] Narayanaswami, V , SCIENCE AND CULTURE, *14*, 38, 1948
[2] Safford, *Jour Wash Acad Sc* , *11*, 173, 1921
[3] Readers may also consult Safford's second paper on the same subject in the Annual Report of Smithsonian Institution for 1920, p 537-567, 1922
[4] Clarkes, C B , Flora of British India, *4*, 242, 1883

II

This criticism does not seem to be based upon examination of the actual materials of *Datura* species both in the field and in the Herbarium Authentication of the systematic position does not mean blindly adverting to what an old author stated perhaps without any examination of our Indian materials both in the field and in the Herbarium Systematic Botanists like Gamble, Haines, Kanjilal and Das, who published the floras of Madras (1923), Behar and Orissa (1922) and Assam (1939) respectively have retained *Datura fastuosa* L as a good species Gamble who worked on the Flora of Madras at the Kew Herbarium, and had the benefit of Mr T Sprague, a recognized authority on nomenclature and the library of Kew for consultation and reference did not seem to have become wiser by Safford's paper which the author must have seen Haines completed his Botany of Behar and Orissa also in the Kew Herbarium and had similar opportunities like Gamble Ridley in his Flora of the Malayan Peninsula (1923) recognized two varieties *typica* and *alba* under *D fastuosa* Das, who had the assistance of Dr D Chatterjee himself for the revision of the nomenclature of the specific names in the Flora of Assam (III) has not been made wiser by Dr Chatterjee with regard to this common Indian species of *Datura*

The correct position regarding several forms of this most protean species of *Datura* particularly with reference to the variations under different climatic and edaphic conditions need clarification That there are morphological differences variable in this species of *Datura metel* L, no one, who has seen the species both in Nature throughout India and in the Herbarium with comments of such distinguished botanists as Sir David Prain and others, can shut his eyes to these facts There is also a long standing belief throughout India that the purple flowered *Datura* is more valued in medicine than the white flowered one and that this form retains its particular distinctive character from generation to generation Morphologically the spiny covering on the fruits of some forms is indeed very characteristic, to which Gamble (*loc cit*) has drawn special attention and he called it *D fastuosa* L Linnaeus himself (*Syst Nat* 2, 932, 1759) has maintained this distinction as characteristic of *D fastuosa* under *D metel* L and has not abandoned it as mentioned by Chatterjee

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THEORY OF SEDIMENTATION IN ULTRACENTRIFUGE AND INTERPRETATION OF THE SCHLIEREN PHOTOGRAPHS

The "Schlieren" methods[1] are very convenient for determining the degree of dispersity of the substances analysed in the Ultracentrifuge, like the proteins But so far it has not been possible (*i*) either to explain the occurrence of the so-called "sedimentation heads" from the theory of diffusion under a centrifugal field, and (*ii*) to gather informations about the molecular weight and diffusion constant of the substance from the rate of movement of the "sedimentation head" The "sedimentation head" appears at a point in the Ultracentrifuge cell, where the rate of increase of the concentration (more precisely, the refractive index) with respect to the distance from the axis of rotation is a maximum[2] The theory of sedimentation must prove the existence of such a maximum

The differential equation for the sedimentation under a centrifugal field can be derived from the general equation of diffusion under a field of force given by Smoluchowski[3], for a sector-shaped cell moving in a centrifuge, the equation becomes,

$$\frac{\partial c}{\partial t} = \frac{D}{r}\frac{\partial}{\partial r}\left(r\frac{\partial c}{\partial r} - \frac{s\omega^2}{D} r^2 c \right) \qquad (1)$$

where,

c = concentration of the substance at any time t at a distance r from the axis of rotation
D = diffusion constant,
s = sedimentation constant,
ω = angular speed of rotation

This equation was also derived *ab initio* by Lamm[4] and was investigated by Faxen,[5] Söyten[6] and Archibald,[7] the last named first succeeded in effecting a complete solution in terms of certain eigenfunctions

The boundary condition for the problem is

$$\frac{\partial c}{\partial r} - \frac{s\omega^2}{D} r\, c = 0 \qquad (2)$$

at $r = l$ which is nothing else than the law of conservation of matter, and

$$c(t, r) = c_0 \text{ when } t = 0 \qquad (3)$$

The "Schlieren" photographs can be explained, if the existence of a maximum of $\frac{\partial c}{\partial r}$ is proved, under equilibrium distribution, *i e*, when $\frac{\partial c}{\partial t} = 0$, no such maximum exists Evidently, the problem is to investigate on the occurrence of the zeros of the function $\frac{\partial^2 c}{\partial r^2}$, and as such a solution in a power series

in r is necessary. The equations (1) and (2) can be transformed to

$$\frac{\partial c}{\partial \tau} = x\frac{\partial^2 c}{\partial x^2} + (1-x)\frac{\partial c}{\partial x} - c \tag{1'}$$

$$\frac{\partial c}{\partial x} - c = 0, \text{ when } x = \frac{s\omega^2}{2D} l = b \text{ (say)} \tag{2'}$$

where

$$x = \frac{s\omega^2}{2D} r^2, \quad \tau = s\omega^2 t \tag{4}$$

Let $u(s, x)$ be the Laplace transform[8, 9] of $c(\tau, x)$ i e ,

$$u(s, x) = \int_0^\infty e^{-s\tau} c(\tau, x)\, d\tau \tag{5}$$

Then from (1') and (3) we get,

$$x\frac{d^2u}{dx^2} + (1-x)\frac{du}{dx} - (s+1)u = -c_0 \tag{6}$$

$$\frac{du}{dx} - u = 0 \text{ when } x = b \tag{7}$$

By substituting $v = e^{-x}u$ the equations (6) and (7) can be transformed into

$$x\frac{d^2v}{dx^2} + (1+x)\frac{dv}{dx} - sv = -c_0 e^{-x} \tag{6'}$$

$$\frac{dv}{dx} = 0, \text{ when } x = b \tag{7'}$$

The solution of this boundary problem which is regular at the origin is,

$$u = e^x v = \frac{c_0}{s+1} e^x \left\{ e^{-x} + e^{-b}\frac{F(s,x)}{F(s,b)} \right\} \tag{8}$$

where

$$F(s, x) \equiv 1 + sx + \frac{s(s-1)}{(2!)^2}x^2 + \frac{s(s-1)(s-2)}{(3!)^2}x^3 + \tag{9}$$

is an integral function of s and x, and is very simply related to the Laguerre function. By inversion of (5) we get

$$c(\tau, x) = c_0 e^{-\tau} + c_0\frac{e^x}{e^b}\int_{\sigma-i\infty}^{\sigma+i\infty} \frac{e^{s\tau} F(s, x)}{(s+1)F'(s,b)}\, ds \tag{10}$$

where $\sigma > o$

This expression for $c(\tau, x)$ can be transformed into a power series in x, viz ,

$$c(\tau, x) = c_0 e^{-\tau} + c_0\frac{e^x}{e^b}\sum_{n=0}^{\infty}\frac{x^n}{(n!)^2} e^{n\tau}\frac{d^n f(T)}{dT^n}$$

where $T = e^\tau$ and $f(e^\tau)$ is a Dirichlet's series

With the help of this expression for $c(t, r)$ we can prove that (i) $\frac{\partial^2 c}{\partial r^2}$ can have a zero between $r=0$ and $r=l$ under certain circumstances, and (ii) can also obtain an expression for the position of this zero, ζ (say) as a function of t

The details of the work will be embodied in a paper to be published shortly

My thanks are due to Prof M N Saha, for his kind interest in the work, and to the authorities of the Board of Scientific and Industrial Research, Government of India, for providing a scholarship for investigating on the problems of construction and utilisation of the Ultracentrifuge

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KOSI—THE PROBLEM RIVER

I

BAGCHI[1] has made certain comments about the geological investigations of the Kosi river area which require correction He suggests that virtually nothing is known of the geological structure of the Kosi area and that only two visits have been paid to the dam site His remarks are presumably based on a report published by the Central Waterpower Irrigation and Navigation Commission [2] It is true that much more geological work is required in the Kosi area before it can be considered to have been properly surveyed, but it may be pointed out that since the above Preliminary Report was published there have been further visits, some of a prolonged nature, by members of the Geological Survey of India, and that the basic structure and the dam site is now reasonably well known The results of the later

work have been written up in a series of Interim Reports for the engineers concerned

The question of the relative merits of constructing either a single high dam below Tribeni, or three dams on the tributaries upstream thereof, has also been discussed with the engineers The advantage of having a single dam below Tribeni is obvious, provided geological conditions permit A site below Tribeni was selected in October 1946 for detailed study by tunnels and borings, and has been under active investigation, during the last year Both the engineers of CWINC and the Geological Survey of India are aware of the need for further work, which from the inception of the project in 1946 has been along well-known lines, similar to those now proposed by Mr Bagchi It is undesirable, however, frequently to publish preliminary results, since these are liable to successive revision as investigation proceeds, but reference to the Geological Survey office could have dispelled many of the doubts raised by Mr Bagchi

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II

Dr Auden's note will be of very great interest to our readers It is really gratifying to learn that the "engineers of the CWINC and the Geological Survey of India are aware of the need for further work, which from the inception of the project in 1946 has been along well known lines, similar to those proposed by" me Dr Auden himself has conceded that "much more geological work is required in the Kosi area before it can be considered to have been properly surveyed" and it is hardly less than to say that very little is known of the geological structure of the area The article in question was based on published materials and hence what has subsequently developed but not made available to the public could be availed of It was the practice in the Tennessee valley to keep the public informed of the developments even of a technical nature from time to time and the same may helpfully be adopted for our country Dr Auden has mentioned that the merits of having a single dam across the main channel as against three dams across the tributaries have been discussed with engineers but no mention has been made with what results However, we presume that the matter has not been finally settled yet and the lure of having a spectacular dam will not be great with our architects There will not be any objection possibly in having a single dam provided geological and other considerations have been given due weight The public would look forward to the reasons that would finally determine the selection of the dam site with very great interest

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NEW BANDS IN THE ABSORPTION SPECTRUM OF TOLUENE

FOLLOWING the interpretation of the absorption bands of benzene in the near ultraviolet[1], Sponer[2] suggested a similar analysis for the few absorption bands of toluene previously recorded by Savard[3] With a view to investigate the spectrum further we have undertaken a series of experiments at temperatures ranging from 0°C to 250°C with varying initial vapour pressures of toluene The spectrum recorded a large number of bands in the region 2400Å to 2890Å While our experiments were in progress, Ginsberg, Matsen and Robertson[4] published a paper on a similar investigation They have recorded a large number of absorption bands and given an analysis of a number of them on the lines of the previous analysis by

TABLE

NEW BANDS IN THE ABSORPTION SPECTRUM OF TOLUENE

ν vac in cm $^{-1}$	Int	Assignment (origin at 37476 cm $^{-1}$)
34574	0	$-1176-1212-514$
34658	1	$-1176-1012-620$
34764	2	$-1176-1012-514$
34876	1 2	$-2\times1212+456-620$
34983	3	$-2\times1212+456-514$
35087	5	$-1176-1212$
35202	8	-2273
35288	4	$-1176-1012$
35409	2	$-2\times1003-1012+964$, -2×1030 (?)
35496	2 5	$-2\times1212+456$
35604	5	$-1176-1212+528$
35687	0	$-1003-785$
35720	1	$-514-2\times620$
35756	1 5	$-1212-514$
35827	0	$-620-2\times514$
35893	0	-1586
36012	1 5	$-1176-1212+932$
36050	3	$-1176-1212+964$
36160	3	$-2273+964$
36300	0	-1176
36418	1 5	$-1003-59$
36568		$-785-2\times59$

Sponer[2]. The bands recorded by them go up to 2768Å, while in our experiments the data extend on the longer wavelength side up to 2891Å under suitable pressure and temperature. In this extended region there are twenty-three new absorption bands. The bands have been measured on places taken on medium quartz spectrograph. The analysis proposed is essentially in agreement with the analysis of Sponer and others. A more detailed communication on this subject will be published elsewhere.

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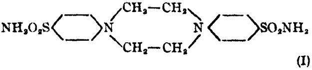
PIPERAZINE DERIVATIVES

During the investigations on alkylene-bis-sulphanilamides,[1] N^1-& N^4-ethylene-bis-sulphanilamides have been prepared by refluxing sodium salt of N^4-acetylsulphanilamide and sulphanilamide respectively with excess of ethylene dibromide.

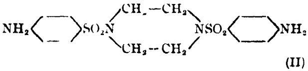
In the case of ethyle-bis-N^4 sulphanilamide, after removing the starting materials from the product obtained by the interaction of sulphanilamide and ethylenedibromide, the solid was repeatedly extracted with boiling water, when ethylene-bis-N^4-sulphanilamide went into solution leaving a small quantity of water insoluble residue. This white water insoluble powder could not be crystallized from common organic solvent and was purified by dissolving it in dilute alkali solution and precipitating it back with mineral acid after treatment with little norite. On further study it was found to be n-n′-bis-(p-sulphonamidophenyl)-piperazine (I) white powder m p 283°C decomposition (Found, N, 14 41 $C_{16}H_{20}O_4N_4S_2$ requires N, 14 14 per cent)



(I)

The yield of the piperazine derivative (I) was only 3% theory, but when sodium carbonate was used during the course of reaction for the neutralization of the liberated hydrobromic acid, the yield was improved.

Similarly after the hydrolysis of the acetyl derivative obtained by the interaction of ethylene dibromide and sodium salt of acetyl-sulphanilamide, with mineral acid, the clear solution was strongly alkalized. Ethylene-bis-N^1-sulphanilamide went into alkali solution due to the presence of free amido hydrogens available in the molecule but an alkali insoluble product remained, which was collected, washed well with water and alcohol and dried. This product contained diazotizable amino groups and was crystallized from nitrobenzene. It was found to be N-N′ bis (sulphanilyl)-piperazine (II). Yield 3% theory, white silky needles, m p 328°C decomposition (Found N, 14 24 $C_{16}H_{20}O_4N_4S_2$ requires N 14 14 per cent)



(II)

In both the above cases, the piperazine derivatives of sulphanilamide have been obtained in small quantities as side products and after searching through literature, it was found that (I) has been previously prepared by the interaction of sulphanilic acid, potassium carbonate and ethylene dibromide and subsequent treatment with ammonia.[2] Kermach and Tebrich[3] have prepared (II) by reacting acetylsulphonylchloride with pierazine and subsequent hydrolysis. The properties of the compounds non reported are in agreement with those reported in literature.

Sulphanilamide substituted piperazine derivatives[4, 5, 6] have not shown encouraging antibacterial activity but recently some alkyl-piperazylalcohols[7] have shown fair activity against avian malaria. It will be interesting to assess the antimalarial property of these compounds.

My thanks are due to Dr P C Guha and Dr B H Iyer for their keen interest and help during the course of these investigations.

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Bangalore, 8-9-1948

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ROLE OF INTERMEDIARY FAT METABOLITES IN CHANGING THE BLOOD SUGAR AND IN ACCELERATING GLYCOGENOLYSIS BOTH *IN VIVO* AND *IN VITRO*

THE hypothesis put forward by Nath and Brahmachari,[1, 2] that the injection of aceto acetic acid and β-hydroxy butyric acid might first stimulate the pancreatic cells of the experimental animals and later cause lesions after fatigue through excessive work, is supported by the recent histological findings of the pancreas of the treated animals at different stages of injection[3] After 26 days of injection of β-hydroxy-butyrate there is an increase in the area of the islets of Langerhans and the size of the nuclei of those cells Similarly after 53 days of injection there appear a distinct sign of degeneration of the islet cells there being no change in the acinar cells whatsoever It has also been recorded recently that gradual increase in the doses is necessary to keep up the hyperglycemic state in the experimental animals[4]

While supporting these views of islet cells stimulation by sodium aceto acetate Tidwell and Axelrod have also suggested the possibility of decreased glycogenolysis by the same But the recent findings by the present authors, both *in vivo* as well as *in vitro*, have proved beyond doubt that the process of glycogenolysis is accelerated rather than retarded by the Sodium salts of aceto acetic acid and other fat metabolites, leaving behind the only possibility of excess stimulation of the islet cells and more secretion of insulin at the first stage of the experiment

Studies *in vivo* have been done with rats, the daily injection of the Sodium salt of β-hydroxy butyric acid being 5 mg per animal Glycogen contents of the liver and muscle were determined according to the usual method[6] and some of the results are shown below

Substance used—β-hydroxy butyric acid (Na salt)
Daily dose—5 mgm per rat

No of Expt	Body wt (in gm)	Experimental period in days	Glycogen in mgm per 100 gm of tissues	
			Liver	Muscle
1 (Normal)	175	Nil	260 0	130 0
2 (,,)	122	Nil	230 0	125 8
3	155	10	173 0	19 2
4	170	25	48 0	29 0
5.	120	55	40 8	20 5

The *in vitro* perfusion experiments were then done with normal liver slice(rat) in Ringer's solution modified by Krebs[7]

2 and 5 mgm of Sodium aceto acetate were found to accelerate the process of glycogenolysis by 44 per cent and 70 per cent respectively in 1 hour's time

All these results show very nicely how the intermediary fat metabolites are greatly responsible for bringing about marked glycogenolysis, a symptom so common in the diabetic individuals and also explain the alteration in the balance between the hepatic glycogenesis and glycogenolysis observed by Mirsky *et al*[8]

These findings also give a clue regarding the possibility of accumulation of excess concentration of sugar in blood when stimulation of insulin secreting mechanism of the pancreas suffers through successive injection of ketone bodies into the experimental animals or through the accumulation of acetone bodies in the diabetics even before the actual degeneration of the islet cells begins

Further investigations are in progress

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Nagpur, 8-9-1948

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ON THE PRODUCTION OF DESIZING AGENT

VARIOUS commercial amylases are used in the desizing of textiles but difficulty arises in their production as well as in their storage[1] particularly in tropics *Aspergillus oryzae* is the common fungus used mostly for this purpose under varying conditions A rapid production and preservation of the enzyme would virtually depend on the nutrients of the medium during cultivation of the moulds[2], the formation of a uniform yellow to yellowish-g lawn of spores and on the absence of any deter ing agent during the process of production, a sequent storage of the enzyme (*cf*, Underkofl Working in this direction it is being notic growth may be hastened by incorporati lysate suitably prepared from oilseeds bran inoculated with the spores of the enzymes formed may be easily afford a powder suitable for desizi

A strain of *A oryzae* was first grown on an usual acidified wheat bran[4] (1 Kg) mixed with one litre of groundnut meal hydrolysate made from 100 gms of the meal by digesting it with 0 1% sulphuric acid at 30 lbs pressure for 2 hours and adjusting the filtrate to *p*H ca 5 0, as well as, with the enzymic hydrolysate made by the method of Basu *et al*[5] The incubation was carried out at 28-30°C in trays in an atmosphere with a humidity of 75-85% for a period of 72 hours The entire mass was covered by a uniform yellow-green lawn of spores This was then extracted with 4 5 gallons of potable water containing 20% sodium chloride and 0 05% thiourea One c c of this extract was added to 50 c c of a 2% solution of corn starch and warmed at 40° C for 8 minutes The lowering of viscosity of the starch solution as noticed from the time of flow in seconds from a double-flask viscometer, was taken as the measure of the enzymatic activity of the mould growth on various experiments carried out in the course of these investigations The extract on concentration *in vacuo* within 45-50°C and subsequent precipitation with methyl alcohol afforded a solid suitable for desizing purposes Details of the paper would be published elsewhere

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COLCHICINE INDUCED AUTOTETRAPLOID JUTE, *C CAPSULARIS* AND *C OLITORIUS* AND THE PROBLEM OF RAISING IMPROVED VARIETIES

Commercial jute is obtained from two different species, *Corchorus capsularis* and *C olitorius* of the family Tiliaceae The bulk of the commercial jute hich feeds the jute mills is obtained from *C capsu-* is which grows plentifully in East Bengal (E stan) Each species has certain advantageous cha- , agricultural and commercial, over the other has been realized by all concerned that there a vast scope for improvement of jute if the of the two species could be suitably com- h hybridization But, as the two species nd to be incompatible[1] [2], the efforts to arieties of jute, made by both the Agri- ut and in recent years by the Indian ittee, have so far been restricted only to selection of strains within the two species It is strange however, that although the incompatibility between the two species is long known, a critical study of the cause of this incompatibility has yet to be made

While work in this direction is in progress in this laboratory, the other line of approach to overcome incompatibility by doubling the chromosomes through the application of colchicine has yielded such promising results that a prompt announcement of the findings, though incomplete, is warranted in creating general interest and drawing attention of those concerned in the improvement of this important crop

Rao *et al*[3] recorded details regarding the successful induction of tetraploidy in one of the species, *C capsularis* From the above account it appears however, that they have failed to continue the tetraploid line which could be used for subsequent breeding work By continued selection since 1944, when tetraploidy in this species was first induced[4] we have been able to maintain a tetraploid line of this species showing improvement in the setting of seeds (from 0-4 to 5-20 viable seeds per capsule) Induction of tetraploidy in the other species, *C olitorius,* which could not be made so long, has become successful this year and we have been able to raise a large number of tetraploid *C olitorius* plants after extensive trials with colchicine both on the seeds and seedlings

A study of the morphological characters of the tetraploids has shown that there has been a general giganticism in the tetraploids with respect to leaves, flowers and fruits The seeds of the tetraploids especially in *C capsularis* are of various sizes, but the viable ones are much bigger than those in their corresponding diploids It will be interesting to know in this connection whether the glucoside contents, 'corchorin' etc ,[5] of the tetraploid seeds and leaves are higher than those of the diploid species The leaves of the tetraploids are more coriaceous and in 4*n* *C olitorius* they are much broader The stomata and epidermal cells are much bigger, but these characters alone are not confirmatory in distinguishing the tetraploids from the diploids, since in colchicine treated population occasional periclinal chimeras are produced which also show bigger stomata and epidermal cells but normal haploid pollen Further, diploid plants with tetraploid branches are also found among the colchicine treated population[6]

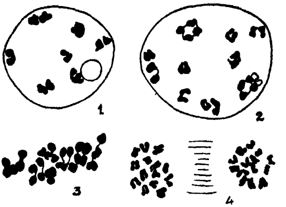
The pollen grains of the tetraploids are roundish with mostly 4 germ pores, while they are somewhat oval in the diploids with usually 3 germ pores The grains are also bigger and their percentage of sterility is much higher especially of *C capsularis* as shown below

Both the diploid species are perfectly fertile and form 7 bivalents ($2n=14$) during meiosis (Fig 1).

Their corresponding autotetraploids on the other hand have 28 chromosomes in their body cells Their P M Cs. are much bigger and show irregularities during meiosis Due to duplication of chromosomes

	C capsularis		*C olitorius*	
	2*n*	4*n*	2*n*	4*n*
Pollen size	37 6μ×30 6μ to 42 3μ×37 6μ	37 6μ to 56 4μ	35 4μ×30 6μ to 44 7μ×37 6μ	37 6μ to 49 4μ
Pollen sterility (% of empty grains)	1%	65 4%	2 3%	8 3%

both univalents and multivalents are formed (Figs 2, 3 & 4) Random disjunction of these, results in the production of aneuploid spores The frequency of quadrivalents in *C capsularis* is higher than in *C olitorius* In the latter a high percentage of bivalents



FIGS 1-4 Meiotic stages of jute Fig 1 Diakinesis in normal 2*n* *C capsularis* (*n*=7) Fig 2 The same in colchicine induced 4*n* plant showing 2 IV+10 II Fig 3 Metaphase I in colchicine induced 4*n* *C olitorius* showing 1 IV+3 III+6 II+3 I Fig 4 Division II in 4*n* *C olitorius* (*n*=14) The equational split of the chromosomes is evident × 3600 (Acetocarmine preparation)

is the rule This is correlated to a higher percentage of healthy pollen grains and a better setting of seeds in the latter species These characters of the autotetraploid form indicate that the diploid *C olitorius* is a structural hybrid Besides due to upset of the timing balance in the pairing of chromosomes a good number of P M Cs in the 4*n* *C capsularis* fail to complete meiosis, thereby further increasing its percentage of sterility

From a large number of reciprocal crosses made during this season between the autotetraploid forms of the two species we have been able to obtain few healthy fruits We expect to raise from these a number of tetraploid hybrids (F_1) next season In a population of such hybrids a few fertile amphidiploids showing a combination of characters of both the species are likely to be produced Even in case the hybrids show sterility, there will still be scope to make them fertile by doubling the chromosomes once again through colchicine treatment Further, selection and breeding work using the F_1 hybrids will offer great possibilities in raising improved strains of jute

Rao *et al*[3] have already pointed out that doubling of chromosomes affect the characters of the fibres in *C capsularis* Although the total number of fibres in a tetraploid plant is the same as that of diploid, the total volume measured from the cross section of the stem shows an increase Whether this will increase the yield (by weight) of jute in such plants has yet to be proved Besides, the physical and chemical properties of the fibres of the tetraploid plants have also to be studied The 4*n* *C olitorius* offers promise in this direction and it is worth the while to grow them in large numbers under different conditions to ascertain whether the tetraploid form of this species can be commercially exploited

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SPECTROGRAPHIC ANALYSIS OF INDIAN COAL ASH

THE ashes of some Indian coals from Jharia, Raniganj, Hyderabad and Assam were analysed chemically by Majumdar[1], the analytical results included only the oxides of Si, Al, Fe, Ti, Mg, Ca, S, P, Mn, K, Na and no other trace element Majumdar found that ashes of Tertiary coals of Assam were almost completely free from Ti

In the present investigation, spectrographic analysis of coal-ash from different coal fields of India was carried out at 10 amps 220 volts with E_1 quartz spectrograph using purified carbon rods[2] The incineration of the coal was made in very thin layers over porcelain basin placed inside an electrical furnace at 400°C The cathode was 5 mm in diameter with a flat plain surface at the end An anode with 10 mm deep bore and 3 mm inner diameter, with wall thickness of 0 8 mm, was most suitable for the analysis A few milligrams of the coal-ash (10 mg

approx) were introduced into the boring of the carbon rod (anode), then slightly compressed and the upper portion of the boring was packed with pure carbon powder The time of exposure was 1 minute The spectral region photographed was 2500 Å—3500 Å In the table only the elements having characteristic lines in the spectral region studied are recorded

carbon rods[2] used as electrodes were not free from boron, the presence of this element in coal-ash could not, however, be definitely ascertained Details of the work will be published shortly

Our best thanks are due to Prof P B Sarkar for his kind interest in the work and for providing laboratory facilities , to the Director, C S I R , for the research grant , and to the Director, Geological Survey of India for kindly supplying the coal samples

TABLE

Specimens of coal ash*	Ash p c	Elements present in traces														
		Ag	Be	Co	Cr	Cu	Ga	Ge	Li	Mo	Ni	Pb	Sc	V	W	Zr
Assam																
1 Garo hills (977-22)	1 63	++	++	(+)		+	+	++	+		++	(+)		+		++
2 Garo-hills (977 7)	2 10	++	(+)	+		+	+	++	+		++	+		+		++
3 Margherita Namdung Colliery	2 78	++				++	+		+		++	+	(+)	++	(+)	++
4 Cherrapunji Colliery	17 94				(+)	++	(+)		+	+	++	(+)	(+)	++	(+)	++
Bengal																
5 Darjeeling Dalingkote Colliery (921, No 7 quary)	12 20			(+)	+	++	(+)	+	+		++	+	(+)	+	(+)	++
6 Dishergarh, Raniganj Coal field	11 20				(+)	++	+		+		++	(+)		++		++
7 Banali, Raniganj Coalfield	6 35				(+)	++	(+)		+		++			++	(+)	++
Bihar																
8 Kargali Colliery, Bokaro Coal-field (No 6 quary)	33 56	++		(+)	(+)	++	++		+		++	+	(+)	++		++
9 Khas-Govindpur Colliery (No V Seam), Katrasgarh, Jharia Coal-field (850)	21 15	++		(+)	+	++	++		+		++	+	(+)	++		++
10 Bird's Katras Chaitridih Colliery, Katrasgarh, Jharia Coal-field (879)	18 01	++		(+)	+	++	++		+		++	+	(+)	++		++
Hyderabad (Dn)																
11 Birley Pit Singarenai Coal field	7 14	++		+	+	++	++	++	+		++	+	(+)	++	(+)	++
12 Tandur	12 40	++		(+)	(+)	++	++	++	+		++	(+)		+		++

++ = large trace, + = small trace (+) = minute trace

* The authors are indebted to Dr R K Dutta Roy and Dr A G Jhingran of G S I , and to Dr J K Chowdhury of Bose Institute, Calcutta, for supplying the specimens of coal

The main constituents of all the coal ashes were the same as that obtained by Majumdar[1] The only difference was that even in the ashes of Tertiary coals of Assam, Ti was present in quite a large amount The importance of the analysis was the detection of germanium and gallium A fair concentration of germanium was detected in the ashes of coal from Birley Pit, Singarenai (Hyderabad) and Garo Hills (977-22) Gallium was present in the ashes of Singarenai coal in considerable traces As the purified

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SCIENCE AND CULTURE

A Monthly Journal of Natural and Cultural Sciences

Vol. 14 DECEMBER 1948 No. 6

CZECHOSLOVAKIA—AN OBJECT LESSON FOR INDIAN ADMINISTRATORS

THEY say that the East of Europe lies behind an iron curtain, but Czechoslovakia is an exception It lies behind an open window Its trade with Western Europe is rapidly increasing, and the technical trade missions recently sent out by this country to the Far East bid fair to open new avenues for exchange of goods and establishment of friendly relations This little country of 130,000 sq kilometers (about 50,000 sq miles) and 12 million people has much to teach us

"On the 30th September last the Czechoslovak Government approved of the Bill for the Five-Year Economic Plan after having heard a detailed exposition by A Zapotocky, the Prime Minister, of its main principles and the preliminary conditions for its fulfilment The Five-Year Plan measure ensures a full development of productive forces and makes possible a planwise increase in the national income by 48 per cent in the course of five years The coming into force of the national insurance scheme means a more rapid consumption, so that the total increase of private consumption *per capita* will, by the end of the five years, be 37 per cent above the 1948 level The trend of the Plan's influence on Czechoslovakia's economy is shown by the following main heads of planned development (See column 2)

In order that the full development of the planned sectors of Czechoslovakia's economy be attained it is necessary for productive work to advance to the extent stipulated in the Plan, in industry by 32 per cent, in agriculture by 20 per cent, in building operations by 53 per cent and in transport by 30 per cent

The situation of the Czechoslovak metal industry is very satisfactory Its exports show a steadily rising trend This was stated by Mr. V Kratky, C E Deputy Manager-General of the Czechoslovak Metal-working and Engineering Works in his report on the metal industry Thus in the year 1946 the exports of Czechoslovak metal products were valid at 1 3 milliard crowns, in the year 1947 at 4 65 millards,

	1948	1953	Rise in %
National Income (in milliards Kcs —1 Re =15 Kcs)	210*	310†	148%
Production			
Industrial output (in milliards Kcs)	288	454	157%
Agricultural output (in millards Kcs)	90	105	116%
Building operations (in milliards Kcs)	20	46	230%
Employment			
Industry, exclusive of small trades (No of persons in thousands)	1362	1616	118%
Agriculture and forestry ,,	2040	1944	95%
Building operations ,,	210	315	150%
Transport ,,	323	343	106%
Consumption			
Per head of population in 1949-1953 (in millards Kcs)	356		135%
Investments			
Social welfare, public health, culture and education	28 6		

* 14,000 crores of rupees
† 21,000 crores of rupees

and for the year 1948 they were planned to reach a total of 10 milliards By the 1st of September of this year, however, contracts already completed and others still in hand, with the end of the year as time-limit for delivery, represented a total of 10 6 milliard crowns "*

* Czechoslovak Economic Bulletin issued by the Czechoslovak Government Trade Commissioner in India—November 1, 1948.

Czechoslovakia thus expects to increase her *per capita* income from Rs 1180 in 1947 to Rs 1660 in 1953 In the years, before we achieved our independence, all sections of the people of India had hopes that plans would be made and executed by our popular Government to achieve a predetermined increase of income for consecutive five year periods This hope has now almost vanished We are having, on the other hand, conferences of economists, bankers, industrialists, provincial ministers, and members of central cabinet with only one object in view—how much of the programme of development of state sponsored enterprises in industries, communication and social welfare, can be axed and how quickly The freedom loving capitalists believe that every state enterprise is a nuisance, but that State should only nurse with protective tariffs and special concessions, the industries which they may start The economists who have the ear of Government believe that money and credit are sacred institutions which should not even be touched by the breath of nonconformists And many bureaucrats in the Indian Civil and Finance Services do not have the elementary idea that real wealth is the result of work done by men with their skill, muscles and machines They have seriously suggested that men and women should be deliberately thrown out of employment so that there would be less purchasing power in the country and cost of living in terms of the rupee might come down Retrenchment Committees are therefore hot favourites in the land These are not the ways to increase our national income or improve the standard of living of our people

The Czech Prime-Minister has shown the way of better living for his people When will our Prime-Minister—the idol of our people and the President of the National Planning Committee which was set up in the days of British Imperialism-give a similar lead to our Country?

ATOMIC FLAMES

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IT is not yet known when the art of making 'Fire' became first known to primitive human societies, but 'fire-making' appears to have made a tremendous impression on early Man, and innumerable myths grew round it 'Fire' or Agni appears to have been one of the Chief Gods of all primitive Aryan people and sacrificial fires were carefully nurtured by the ancestors of Hindus and Parsees In Greek mythology, the friendly Titan Prometheus was supposed to have stolen 'Fire', a guarded secret of gods from Heaven for the benefit of man, and this appears to have enraged the gods as much as the suppositious 'Theft of Nuclear Fire' by the Communists continue to provoke American and British politicians Fire was early used for cooking, lighting, scaring away wild beasts, and burning enemies and their possessions But the innumerable other uses of Fire, for metallurgy, for producing steam to drive engines, and to produce electricity came later, some within living memory

Scientifically, the art of making fire, is nothing but a chemical process in which two or more molecules are made to combine, and heat is evolved Thus when we take the very common-place process of burning of coal, the mechanism can be written as

$$C+O_2=CO+29 \text{ Kcal (incomplete combustion)}$$
$$CO+\tfrac{1}{2}O_2=CO_2+69 \text{ Kcal}$$
$$C+O_2=CO_2+98 \text{ Kcal (complete combustion)}$$

The first process is incomplete burning, the third is complete burning when carbon is completely burnt When a grammolecule of oxygen combines with a gram atom of carbon, 98 kilocalories of heat are evolved, *i e*, we get 8 kilocalories per gram of carbon burnt, and 2 2 kcal per gram of carbon-oxygen mixture Any chemical reaction which evolves 'Heat' can be utilized in place of coal as fuel, provivid other conditions are favourable, for example, we burn petrol which consists of hydrogen compounds of coal, with a mixture of air to drive internal combustion engines During the war, the Germans, faced with shortage of petrol, used hydrogen peroxide, and liquid oxygen for their V_2-Bombs, and many other kinds of fuel were tried

All these processes involve chemical reactions between different kinds of molecules, and the amount of heat produced per gram of fuel burnt is rather limited It was apparent to fuel scientists, that "atomic reactions" would give much larger amounts of heat per gram of fuel consumed Thus if two gms of atomic hydrogen were to combine with sixteen gms of atomic oxygen the amount of heat produced would be

$$2H+O=H_2O+102+59+68=H_2O+229 \text{ (Kcal)}$$

102 Kcal is the heat evolved when two gm atoms of hydrogen combine to form one gm mole

cule of H_2, 117 4 is the heat evolved when two gm atoms of oxygen combine to form one gm molecule, and 136 Kcal is the amount of heat evolved when two gm-molecules of Hydrogen gas combine with one gm-molecule of oxygen to form one gm-molecule of water We get nearly 13 Kcal of heat per gm of fuel consumed whereas in ordinary burning of carbon, we get only 2 2 Kcal per gm of total fuel burnt

If only two atoms of hydrogen can be made to combine directly we get 102 Kcal, *i e*, nearly 51 Kcal per gm of fuel

It is apparent that as far as production of heat is concerned, Atomic Fuels will be far better producers of energy than ordinary molecular fuels, whether in the form of solid, liquid or gas, but there are other important factors which stands in the way

First, the probable fuels hydrogen, oxygen etc are found in Nature in the combined state, and it requires great effort accompanied with expenditure of energy to split them into atoms Secondly it is not possible to store "atomic fuels" They must be spent as soon as produced There are other tremendous difficulties in handling

The first difficulty was overcome when Wood, (1922) discovered easy methods of producing atomic hydrogen in bulk He observed that if a high current discharge is passed through hydrogen at a pressure of 01 mm or so, in a wide discharge tube a metre long, then an appreciable proportion of molecules of hydrogen in the middle of the discharge tube are converted to atomic hydrogen

This is indicated by the fact that the many lined, or secondary spectrum of hydrogen, which is indicative of the H_2-molecule, is confined to regions near the electrodes, while the central portion of the tube shows the Balmer Lines very prominently, almost free from the molecular lines By using the tube end on, Wood was able to photograph the Balmer series to the 20th member, which was a considerable advance, considering that the intensity of the 20th member is only 1/250th of that of the 12th, the last line usually photographed in the laboratory Accurate measurements within a few thousands of an Angstrom were also made by him upto the 18th member by photographing the series in the third order spectrum of a 7 inch plane grating with a lens of 20 ft focus This showed that by this simple expedient, a large fraction of H_2-molecules can be converted to atoms a fraction of which is highly excited

Bonhoeffer utilised (1927) Wood's method of obtaining atomic hydrogen in quantity for producing flames burning in atomic hydrogen and examining their spectra [2] He also investigated in greater detail the chemical and physical properties of atomic hydrogen This work was later extended by Harteck and Kopsch (1931) to the production of flames in atomic oxygen Since then a good deal of research has been made upon the chemical properties of atomic *hydrogen and atomic oxygen* by Geib, Harteck, Steacie and others, the earlier researches are summarised by Geib (1936) While later work is dealt with by Steacie in his recent book 'Atomic and Free Radical Reactions'[3] (Reinhold, 1946)

Since the subject is rather extensive an attempt is made in this article to describe the more well known properties of atomic hydrogen and atomic oxygen and in particular their utilisation for the production of flames for spectroscopic examination The apparatus is described below since it illustrates the principles very well (Fig 1)

Hydrogen from a compressed gas cylinder, after passing through a flow-meter, enters the long discharge tube at the top The discharge tube, 2 5 cms in diameter, is a metre and half long, bent in the middle so that the tube appears U in shape The

[1] Present day conventional use of the term atomic energy or atomic fuel actually mean nuclear energy and is a misnomer.

[2] For the measurement of concentration of hydrogen atoms a method has been devised by Wrede and Harteck (*Zs f Physik, 54*, 53, 1929) It is however applicable only where the atomic concentration is fairly large such as in the Wood type of discharge tube The principle is that if a stream of gas containing both atoms and molecules is led through a capillary whose bore is less than the mean free path of the gas, then the flow of gas through the capillary is mainly by diffusion Inside, therefore, we have only molecules passing through the capillary and on the outside both atoms and molecules In the steady state the pressure will be lower inside than outside and the volume per cent of atoms (n) is given by

$$n = \frac{100\ (P_1 - P_2)}{P_2\ (1\text{-}0\ 5\ 2)}$$

where P_2 is the pressure outside and P_1 that on the inside The pressure is generally measured by the Pirani gauge

Calorimetric methods have also been used for measuring the atomic concentration since the heat of recombination is fairly high Thus, Schwab and Friess (*Zs f Elektrochemie, 39*, 586, 1933, for absolute measurments used a calorimeter consisting of a thin metal plate to which a thermocouple was attached The calorimeter was previously calibrated by heating it electrically so that the amount of heat generated on account of atomic recombination could be known

More recently, Melville and Robb (conference on labile molecule, Oxford, 1947) have described a method for measuring atomic hydrogen atoms react with molybdenum trioxide the oxide turns blue, and the measure of the blueness of the colour gives the concentration of the atoms The amount of blueness is measured by the intensity of light reflected from the surface which can be measured by a photo-electric cell

[3] Early in 1939, the author in collaboration with Dr Geib had obtained preliminary results on the spectra of hydrocarbon flames, utilising the apparatus available in the laboratory of Prof K F Bonhoeffer at the University of Leipzig Similar apparatus has now been set up by him in the laboratory of Prof Sir Alfred Egerton for the study of the spectrum of deutero-acetylene burning in atomic oxygen in order to determine the emitter of the hydrocarbon flame bands by means of isotopic shift

electrodes are made of hollow aluminium cylinders and connection is made with the secondary of the transformer through tungsten wires sealed in the glass The primary of the transformer takes 20 amps

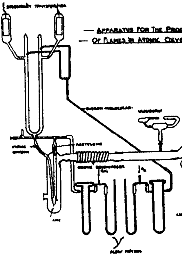

FIG 1

from 220 volts, main supply During the running of the discharge the electrodes are cooled by a fan A stream of unrecombined atoms is tapped off from the middle of the discharge tube and this enters the reaction vessel where it meets acetylene or any other gas whose flame is under investigation The products of combustion are pumped off by a fast mercury pump, condensable products being collected in a liquid air trap pressure is indicated by a vacuostat

In case of atomic oxygen an additional precaution is necessary owing to the formation of ozone Ozone is got rid off by decomposing it by passing over a strip of platinum heated electrically to dull red heat

CHEMICAL PROPERTIES OF ATOMIC HYDROGEN

Chemical properties of atomic hydrogen have been investigated by Bonhoeffer by drawing the stream of atomic hydrogen through a side tube off the main discharge If small pieces of sulphur are placed at different distances the reactivity of atomic hydrogen with sulphur falls with increasing distance from the main discharge and hence the life time of the atomic hydrogen can be calculated It was found to be of the order of 1/3 second at a pressure of 0 5 mm and the gas streaming at 30 cms per second The life time can be increased to 1 second if the streaming velocity is increased and the pressure lowered to 0 1 mm Even the life time of 1/3 sec at the pressure of 0 5 mm and 50 cms streaming velocity is quite high, the reason being that not every collision leads to the formation of a molecule In order that a molecule be successfully formed by collision between hydrogen atoms it is necessary that a third body be present to abstract the liberated energy If a tungsten wire is sealed in the path of the stream of atomic hydrogen it becomes red hot on account of the generation of heat of recombination of hydrogen atoms All metals do not promote the recombination to the same degree Conversely, there are substances which prevent the recombination of hydrogen atoms, important among these are water, phosphoric acid and potassium chloride When a high yield of hydrogen atoms is needed it is usual to poison the walls of the discharge tube by coating them with water or phosphoric acid The same object is achieved by using moist hydrogen

One important industrial application of the large amount of heat liberated by the recombination of hydrogen atoms is the Langmuir's hydrogen torch for high temperature welding (Fig 2)

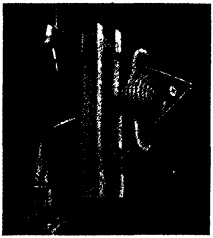

FIG 2 The Hydrogen Torch

In this case an arc is struck between two tungsten electrodes against which is flown a stream of atomic hydrogen, which then burns with a fan-like appearance With 14 amps from 440 v d c and 2 mm distance between the electrodes the temperature is greater than 3500°K at a distance of 4 cms from the arc while it will be considerably greater at the arc itself Thus, molybdenum with a melting point of 2900°K could easily be melted at a little distance from the arc while tungsten with a melting point of 3600°K could be melted in the arc itself In the arc the Balmer lines were strongly emitted while they were absent in the flame which gave the HO bands in the ultra violet One additional advantage in using hydrogen is that metals are not oxidised,

Atomic Oxygen

Atomic oxygen can be prepared by the same technique as atomic hydrogen One important complication when atomic oxygen is produced by the Wood discharge tube is the formation of ozone By absorption of light of wave length 2537A it can be shown that the concentration of ozone in the stream of gas coming out of the discharge tube possessing fair proportion of oxygen atoms in the neighbourhood of 1 per mil If the gas is cooled by solid CO_2 the proportion of ozone rises to 2 per cent while if liquid air is used it can be raised still higher If one assumes that ozone is formed as a result of a three body collision, $O+O_2 \rightarrow O_3$ while the decomposition of ozone occurs as a result of an encounter with oxygen atoms $O+O_3 \rightarrow O_2$ taking place at every two thousandth collision, it is possible to calculate what stationary concentration of ozone should be at the room temperature , and the amount of ozone found in the above experiments is not far from that calculated This shows that the ozone formation is through a three body collision between an atom of oxygen and a molecule of oxygen .

Owing to the danger of explosion if ozone were condensed in the liquid air trap when running flames in atomic oxygen, it is decomposed initially by passing the effluent gases over a platinum strip heated electrically to a dull red heat

Chemical properties —Under favourable conditions the concentration of atomic oxygen in the gas from the discharge tube can be as high as 30 per cent The reactivity with different substances varies, however, considerably Molecular hydrogen, water and methane are attacked only to a very small extent , CO about 5 per cent, while acetylene, benzene, methyl alcohol and ethyl alcohol react very rapidly For spectroscopic investigations acetylene gives a bright flame very suitable for detailed examination

Individual chemical reactions are discussed below

Hydrogen and Water —The reactivity with molecular oxygen is very little, as a matter of fact only 3 per cent of water is formed if amount of water formation is taken as a measure of the reactivity It is considered that water is formed according to the equation

$$H_2+O=OH+H+1 \text{ Cal}$$

the hydroxyl being then able to react further to give water according to

$$2OH=H_2O+O$$

No hydrogen peroxide was detected, nor was OH radical found in emission This is in marked contrast with the reaction of atomic hydrogen with molecular oxygen where OH appeared in emission and hydrogen peroxide was collected among the condensed products.

Chemical reaction —The interaction between atomic hydrogen and molecular oxygen is not very rapid, but it gives a flame which shows the OH bands Among the products are water and hydrogen peroxide whose yield increases to almost hundred per cent at liquid air temperature

Atomic hydrogen has no reactions with nitrogen, ammonia nor with carbon monoxide and carbon dioxide With chlorine and bromine however the reaction is very rapid, which is readily understood because these reactions are strongly exothermic Mono-halogen substitution products of methane react rapidly so does hydrogen sulphide which is reduced to sulphur With hydrocarbons excepting methane the reaction produces a pale blue flame which shows the C_2 and CH bands as also the Balmer series which is from the reflected light (Fig IIIa) By examining the products of reactions with hydrocarbons it has been concluded that the reaction proceeds through hydrogenation, dehydrogenation and the rupture of C−C band These principles are discussed in detail taking the reaction between atomic hydrogen and acetylene as an example

Many of these intermediate reactions are known only from spectroscopic evidence, and are sometimes difficult to interpret But the hydrogen in all hydrogenous compounds can be replaced by its isotope, heavy hydrogen or deuterium, and when the flames of these compounds are studied with the spectroscope much further light is thrown on the course of the reaction

As an example, we take the reaction of atomic hydrogen with acetylene

Acetylene —In reacting with hydrogen atoms acetylene give a pale blue flame which shows the CH and C_2 bands , acetylene can however be recovered completely undecomposed after the reaction though in the presence of acetylene, catalytic recombination of hydrogen atoms is greatly promoted A series of reactions must therefore take place which result in consumption of hydrogen atoms and subsequent regeneration of acetylene

Experiments with deuterium atoms prepared by Wood type of discharge tube substantiate the conclusion In this case it was found that the final product viz acetylene was almost in deutero-acetylene form C_2HD The mechanism suggested is

$$C_2H_2+D \rightarrow C_2H+HD, \quad C_2H+D \rightarrow C_2HD$$

The appearance of CH and C_2 bands could be through dehydrogenation and splitting of C_2H radical

In the alternative mechanism

$$C_2H_2+D \rightarrow C_2H+HD, \quad C_2H+D_2 \rightarrow C_2HD+D$$

deuterium atoms are removed by the first reaction and regenerated by the second, so that there is nc

catalytic recombination of deuterium atoms and hence this mechanism can be ruled out If the formation of deuterium atoms and hence this mechanism can be ruled out If the formation of a quasi-molecule is assumed viz

$$C_2H_2 + D \rightarrow C_2H_2D,\ C_2H_2D + D \rightarrow C_2HD + HO$$

then $D + C_2H_2D \rightarrow C_2H_2D_2$ also is likely, provided the quasi-molecule has long enough life, which means that a certain amount of ethylene should be formed, but no hydrogenation to ethylene was found in reactions with hydrogen atoms from Wood's discharge tube even though metal catalysts are known to promote hydrogenation of acetylene to ethylene Hydrogenation to ethane, butane and a partially hydrogenated polymer was however found in experiments with hydrogen atoms produced by mercury photosensitisation and the rate of hydrogenation increased considerably with temperature These results are explained by assuming an initial formation of the C_2H_3 (Vinyl radical,)

$$H + C_2H_2 \rightarrow C_2H_3$$

or by $H + C_2H_2 \rightarrow C_2H + H_2$, followed by

$$C_2H + H_2 \rightarrow C_2H_3$$

With the high H atomic concentration in the discharge tube, the reactions occurring most readily are

$$H + C_2H_3 \rightarrow C_2H_2 + H_2 H + C_2H \rightarrow C_2H_2$$

which explains the absence of hydrogenation in the discharge tube method while with photo-sensitisation method we have

$$C_2H_3 + H_2 \rightarrow C_2H_4 + H,\ C_2H_5 + H_2 \rightarrow C_2H_6,$$
$$C_2H + H_2 \rightarrow C_2H_3$$

The higher paraffins can be formed by subsequent reactions

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ATOMIC ENERGY POLICY*

PROF BLACKETT author of the book under review is Professor of Physics in the Victoria University, Manchester, and is well known in the international scientific world as one of the great outstanding workers on Cosmic Rays, was drawn, like many other eminent scientists of Britain, into war-service during World War II He is the originator of methods of Operational Research which was largely responsible for the defeat of German submarine menace in the seas round about Britain He has written this book, as he tells us in preface "to find out a rational basis for policy for the United Kingdom in respect to Atomic Energy " As a member of the Advisory Committee on Atomic Energy, set up by the British Government in 1945, Blackett was officially connected with the formulation of the policy which led to the start represented by the Atlee-Truman-King declaration in November 1945, and the setting up of the United Nations Atomic Energy Commission in January 1946, a debating body whose labours came to a close in June 1948, owing to wide divergence of views between the Anglo-American and Soviet groups of nations Blackett says

> "The conviction grew in my mind that the policies of Britain and U S A —for, in essentials, the two appeared to be the same—were following the paths which were as unrealistic in their military basis as they are likely to be in their political consequences "

It requires a courageous man to take up such an attitude, but Professor Blackett has not flinched from his self-imposed task His fifteen chapters of nearly 200 pages, and several pages of appendices are all well-documented, and he argues from first hand data with the cold logic of a professional scientist He follows Charles Babbage

> "Nor let it be feared that erroneous deductions may be made from such facts, the errors which arise from absence of such facts are far more numerous than those which result from unsound reasoning respecting true facts "

There are extreme views about the efficiency of the Atom Bomb as a military weapon One party holds The Atomic Bomb has almost certainly relegated all other weapons of modern war—tank, battleships, guns, rifles and trained masses—to the museum (Sir William Beveridge) the other extreme opinion is that Atomic Bomb is just another more new weapon, and will eventually be absorbed as in innumerable cases in the past, into the practice of the military art, without essentially changing its character Somewhere, of course, between the extremes, lies the truth

Professor Blackett's analysis shows·

(1) That the atom bombs which were dropped on Hiroshima and Nagasaki were equivalent in their destruc-

* *Military and Political Consequences of Atomic Energy* —by Prof P M S Blackett, F R S, Turnstile Press, London, W C 1

tive power to 2000 tons of ordinary bomb, a load which requires nearly 200 superfortresses to carry Though the potential capacity is equal to a bomb load of 20,000 tons, 90 per cent of this is wasted on account of the fact that most of the energy is spent about the target, which is too much pulverized

(2) That it should be possible to carry the atom bomb safely over the target, but this s possible only

(i) when the aggressor has complete air mastery over the intended victims as Americans had over Japan prior to Hiroshima bombing
(ii) when the aggressor commits a surprise attack as the Japanese did over Pearl Harbour
(iii) when the Atomic Bomb can be hurled from distances over 1,000 miles, by means of some kind of V_2-rocket, as part of a push button warfare

The third alternative is considered impracticable at the present stage of development says Dr K T Compton, America's No 1, War Scientific Research leader in his report to the U S A Government

"The era of the pushbutton warfare in which inter-continental rockets with atomic warheads would wipe out tens of millions overnight has not yet arrived It is extremely unfortunate that the misinformations have planted in so many minds that the era is now present"

On account of the distance of the Russian homeland, wide scatter of her cities, and Russia's undoubted air-strength, it is not considered very probable that the U S A will be able to defeat Russia by the use of her present stock of Atom Bombs alone Simultaneous use of other weapons of war, air-bombing, mechanised land forces, and naval warfare are necessary to achieve this end, but prospects of success are not very rosy, in view of the extreme unwillingness of West European countries (including even a large section in Britain, of which Professor Blackett is one) to allow their territories to be used as a jumping board for action, on account of the fear that Russia may possibly occupy Western Europe up to the Atlantic within 48 hours of declaration of hostilities

Blackett is very sarcastic He quotes from official documents of U S A Government

"In the military thinking of the United States, the acquisition of adequate far-flung bases is continually being stressed, and from a military point of view, correctly so For instance, we read that the Navy Department's view, in relation to the possible use of V-2 types of weapons is

What is necessary to reach the target is a launching base relatively near the target—to put it literally, within five hundred miles

Under the conditions of war in which atomic bombs are available to a possible enemy, the importance of depriving the enemy of bases near one's own shore and preferably of acquiring and maintaining bases close to his territory remains as great as before The logic supporting this proposition derives from the characteristics of atomic bomb carriers presently known or conceivable The outlying base, if properly placed, is also a tremendous advantage to the defence as a further measure of protection against long-range bombing aircraft For such bases provide means of advance protection and interception which greatly augments the obstacles to penetration of vital territories by attacking bombers These bases may themselves be vulnerable to atomic bomb attack, but so long as they are there, they are not likely to be by-passed In this respect the advanced base may be likened to the pawns in front of the king on a chess-board, meagre though their power may be individually, so long as they exist and the king stays severely behind them, he is safe

Impeccable military logic! Pawns—Britain, France, and Scandinavia—protecting King America and receiving the bombs!

From a political point of view then, of vital importance to counteract our loss of the cushion of time is a need for allies We cannot stand alone in the world to-day, if for no other reason, for lack of strength to do so The shock of a powerful aggressor, with modern weapons, including the atomic bomb, can better be absorbed by a number of nations than by a single nation The ability to retaliate promptly, and eventually to overcome the aggressor, likewise, is dependent, if success is to be reasonably certain on bases, resources, and forces dispersed in more than one nation

No easy criticism can be levelled at this clear statement of a military truism Britain clearly is in a fix, destined by American military thought to provide the essential 'cushion in time' by absorbing the atomic bombs"

According to Blackett, the present tension between the Anglo-American and the Soviet group is a continuation of the "Cold War" which has always been in existence since the emergence of the communistic state The menace of Nazism made rather strange bed fellows of the Anglo-American and Soviet blocks but the mutual suspicion, and distrust of each other's motives have not only revived after the disappearance of Hitler, but has intensified a hundred fold Blackett severely criticises the dropping of Atomic Bombs on the two Japanese cities His arguments are

(1) That Japan was virtually on the verge of collapse, and had already started negotiations for surrender Far more damage was done by ordinary air bombing of Tokyo, and Japan's air and naval force was almost wiped out

(2) That the decision to drop Atomic Bomb was taken, not so much with the view to compel Japan to surrender, or give her rulers an excuse to surrender as has been given out by certain politicians but with a view to demonstrate to Russia, which was mobilising her army to sweep over Japanese held Manchuria, Korea and North China, that America possessed a weapon with which she could bid a halt to Russia's occupation of the whole of Eastern Asia Further the quick surrender of Japan, which was anticipated, enabled U S A to occupy Japan and Southern Korea with her land-armies, and thus secure a spring board for action against Russia before she could move to occupy these regions

The deadly effect of the Bomb could be demonstrated by dropping them on lonely islands, but then 1,20,000 men would not have been killed at one stroke, and the action would have lost its dramatic effect

In fact, Blackett quotes from the Franck report (June 1945) containing the findings and opinions of a Committee of Chicago scientists (who were responsible for the evolution of the atom bomb) presided over by the German refugee scientist, James Franck, that the atom bomb should *not* be used over any Japanese city This was 2 months before the decision was taken up by President Truman on the advice of another group of American scientists, to drop the bombs over the two Japanese cities, which was done on August 8 Professor Blackett points out that the big three had a conference at Potsdam on July 20, 1945, and the Anglo-American representatives had a knowledge of the Los Alamos experiment on July 16, 1945, which first revealed the deadly nature of the Atom Bomb, but this fact was carefully withheld from the Russian representatives The ultimatum to Japan to surrender was issued on July 26, by the Big Three According to the agreement amongst them, Russia was to have declared war on Japan on August 8, which she actually did, but the bomb was dropped two days earlier, ostensibly to frighten Japan to surrender, but actually to enable U S A to occupy Japan and as much of Korea as possible, before Russia moved too far out The 'Bomb' was thus an indirect hint to Russia to call a halt to her forward movements So the plea that the Atom-bomb shortened the war by two years, and saved millions of American lives is not accepted by Professor Blackett

The story of the subsequent cold war is also related with extreme frankness In November 1943, Professor A H Compton on whose advise President Roosevelt started the Atomic Research Programme (The Manhattan Project) and who, as one of the programme chiefs of the project, had complete knowledge of the potentialities and limitation of the Atom Bomb declared in a widely advertized speech, November 16, 1945

"World Government has become inevitable The choice before us is whether we shall elect to fight a catastrophic third world war to determine who shall be master

In a quarrelsome world the only means of ensuring peace is to set up a world government which monopolizes the power to wage war Thus it is that new military developments culminating in the atomic bomb make inevitable a world government

The fact is that the United States now has in its possession a sufficient monopoly of weapons needed for such policing that it might be able to act in this capacity of world police What is needed is an agreement which will make the safety of America much surer than could result from her own armed might

Having made war intolerable because of its enormous destructive power, it thus opens the way for an international organisation to prevent war from ever occurring again"

The 'Atom-bomb' therefore has given rise to such a volume of fear in the world, and distrust amongst the "quondam allies" that nobody knows how to get out of it After the termination of the war, the effect on the American mind has been to pass from one of extreme nervousness, about her own security, lest any other country, particularly Russia, gets the secret of Atomic Bomb, and can manufacture them in sufficient quantity for use against the U S A A section of her politicians therefore now began to clamour for 'Hundred per cent security'', which means elimination of Soviet Russia as a great Power But the "comradeship" was too recent to justify adoption of such a step, and probably from the knowledge, as Blackett quotes from the Franck Report, circulation of which was carefully suppressed by the U S A Government that the Atom Bomb would be ineffective against Russia and China, and would only have meant indiscriminate and purposeless slaughter of men without forcing any definite issue

This gives the key to the intricate tangle of proposals and counter proposals, carried on during the past two years which has puzzled the world The Baruch plan, submitted before the U N O *debating body*, called the Atomic Energy Commission, started with very pious motives, pleading for international control, and use of Atomic Energy for the benefit of mankind, but to give effect to these ideas, they recommended inspection by an international agency of all Atomic Energy works in all countries including U S A This was objected to Russia, because this would have revealed her weaknesses and her elaborate preparations for Atomic Energy Work to the allies, while she had nothing to gain, as the knowledge of America's Atomic Energy Works was almost fully available She put forward counter proposals in which she wanted use of Atomic Energy in any form for war purpose to be completely outlawed, and destruction of all atomic weapons In other words, she wanted the present menace to her arising from America's possession of stock piles of atomic weapons, to be completely removed for her own security, while the U S A wanted for her own eventual security, all knowledge of what Russia is actually doing to develop atomic weapons

"In detail the Baruch plan failed because in its attempts to secure nearly complete security for America it was inevitably driven to propose a course of action which would have put the Soviet Union in a situation where she would have been subservient to a group of nations dominated by America Since America would keep her Atomic Bombs till at late stage in the process of setting the control in operation, the Soviet Union would have no firm guarantee when the stage was reached at which the Bombs should be

disposed of, some technical point would not be raised to justify retaining them In the meantime she would have thrown her land and economy open to inspection and so inevitably to military espionage "

It is therefore natural that the negotiations should come to a deadlock But what next?

That the U S A is completely alert to danger, eventually arising from Russia's ability to manufacture atomic weapons in sufficient quantity is clear from the two reports 'The Report by K T Compton, May 1947, which recommends training of the Americans to compulsory military service, and simultaneous development of all arms of the war —land army, navy, and air,—and intensification of research on defence It admits practically that as long as Russia's air-defence is intact, not much can be expected from the use of atomic weapons, particularly as Russia is in actual or potential occupation of West Europe, and use of atomic weapons over these cities would only wipe out friendly population, and rouse the bitterest feelings The Finletter Report, published in January 1948, recommends intensive development of the Air force as an arm of defence and offence "

According to Blackett's analysis, the future is surcharged with the most dangerous possibilities

"Without the elimination of the atomic armament race by the International Organisation the two worlds which are shaping up now will not be merely two competing economic systems but two camps of enemies armed to the teeth and watching each other's preparations in hysterical anguish "

How can we avoid such a situation? Blackett clearly perceives that "the only possible way in which the American people can obtain complete safety from atomic bombs is by effective American control of all other nations" *i e* by having *One Power World,* instead of Wilkie's One World, as we put in 1945 Blackett perceives that One Power World, even if initiated by consent (this is extremely problematical) could only be maintained by force

It is more than that It is certain that Soviet Russia and her satellites could not be brought under the One Power World scheme under American hegemony, except through a totally-waged war! What does that mean? Use of nearly 20,000 Atom Bombs, use of countless aeroplanes and other weapons and slaughter of millions of belligerents, and larger number of nonbelligerents who want to live in peace, and destruction of most cities and monuments of civilisations which have taken several millenia to build up! Even the most bellicose politicians are staggered by the thought! Hence the prospects of a third World War are much less for a few years to come than is generally thought

Blackett advises that negotiations should be carried out in an atmosphere of reality in a bargaining, give-and-take spirit But would that advice be accepted by partisans of King Capital and King Communism, or would they rush into war like the sons of Emperor Aurangzeb who on the death of that emperor flew into each other's throat holding that "Two Faquirs can share a blankett, but two kings cannot share a kingdom!" A change of heart, and mutual toleration is needed if mankind is to escape the horrors of a third World-War!

There is a school of thought that researches on Atomic Energy should be altogether banned as they have led to deterioration of world peace To them, Blackett says indignantly

"To conclude however that Mankind must be prepared to forego the beneficial use of Atomic Power for fear of the destructive use of the Atomic Bombs is like counselling men never to fly because they may crash never to swim because they may drown, never to light a fire lest to burn their house, or perhaps more aptly to propose the abolition of medical inoculation lest bacteriological weapons are made on this line This way lies the road to anxiety neurosis and the madhouse "

Peace Time Uses of Atomic Energy

Blackett devotes a chapter on peacetime uses of Atomic Energy He says

"The Indian physicist Professor Saha[1] has shown that the very wide difference in the wealth per head of such an unindustrialized country as India or China to-day, or Western Europe in the Middle Ages, compared with a highly industrialized country such as the U S A (a difference which Saha estimated as about twenty to one) is paralleled by nearly the same difference in total available supplies of energy, including human and animal power He estimates that the energy per head available in India, from other than human labour, is about one-sixtieth of that available in America In India nearly 70 per cent of all energy is from human and animal exertion, in America under 4 per cent

In Table I is given the relative total energy as measured in thermal units produced per head of the population for selected countries, together with the average wealth per head

We notice the striking fact that the energy consumption in 1935 in the U S A was about six times that in the U S S R and some sixty times that in India We see at once the close relationship between power output per head and standard of life It is quite certain that any nation which intends to reach or surpass the present productivity of America—and what nation does not?—must base its plans on the provision of a power supply of at least the magnitude of that in America to-day This implies, for instance, that the U S S R must increase her power supply by

[1] Saha, *Nature, 155,* 221, 1945

six times over that of 1935, and that India must increase hers by some sixty times For the world as a whole to reach the living standards of America requires again a six-fold increase of power supply

TABLE I

REAL INCOME PER HEAD AND TOTAL ENERGY CONSUMPTION FROM COAL, OIL, WATER AND GAS, EXPRESSED AS PERCENTAGE OF THE FIGURES FOR THE U S A

Country	Population millions	Total energy per head	Weath per head
U S A	137	100	100
U K	45	73	77
U S S R	162	18	35
China and India	760	2 ?	11
Total World	2000	16	25

He says that for U S A , Britain, and a number of European countries, who have developed their energy resources to the maximum, development of atomic energy for peacetime purpose is not such a great necessity—in fact one concludes from Blackett's remarks that the great stress for use of Atomic Energy in these countries is more for bellicose purposes, than for extending the frontiers of science

Is there any protection against Atom Bombs?

Blackett says The most instructive fact at Nagasaki was the survival, even when near ground zero, of the few hundred people Few took protection in tunnel shelters Carefully built shelters though unoccupied stood up well in both cities without questions the shelters can protect those who get to them against anything but a direct hit Adequate warning will assure that a maximum would get to shelters Analysis of the protection of the survivors within a few hundred feet of the ground zero, shows that the shielding is possible against-rays Adequate shelters can be built which would reduce substantially the casualties from radiation

It appears that a few feet of concrete or somewhat thickness of earth furnish sufficient protection to humans even those closed to the ground zero to prevent serious after effect from radiations

In connection with the possibility of ensuring a reasonable degree of protection to the individual life of a country the American War Department document already quoted[1] reads as follows

"That success in this respect is not hopeless may be indicated by the historical example of industry's ability to survive, demonstrated by German industry in World War II, which not only survived but increased its production up till 1944 , and the Russian industrial effort, which survived the great German territorial advances which over-ran or destroyed industrial capacity representing equivalent results of an enormous amount of strategic bombing Complete dispersion of our cities over 30,000 population which number some 200 and total fifty million inhabitants, appears beyond our capabilities—not because of the requirements of money or engineering effort, staggering as they are, but because of the political resistance of our people against being regimented uprooted, and forcibly moved

A detailed discussion of the technical problems involved in a policy of dispersal and protection of industries has been given by Marshak, Teller and Klein [2] Their conclusion is that it would be economically possible to 're-locate all urban dwelling, plants and non-moveable equipment' in the United States in this fifteen years at a cost of about a quarter of the national income It is quite clear that any such programme could not be carried out in the United States of America without revolutionary economic changes Yet, leaving aside as quite impossible such a re-location of population and industry as is envisaged by authors quoted above, a not at all negligible degree of protection to essential installations could clearly be attained by a more modest programme Different countries would fare very differently Those of large size, such as America and Russia, could much more easily achieve some degree of protection than small and congested countries like the United Kingdom, which can be considered as indefensible against an atomic bomb attack from bases in north Europe Space is of the greatest value for two reasons It gives the possibility of wide dispersal, and so makes targets difficult to find , and it provides great depth of defence against the aircraft carrying the bombs

Timings

Franck Report—June, 1945
Atom Bomb tried in New Mexico—July 16, 1945
Big 3-Conference at Potsdam—July 20, 1945
Ultimatum to Japan to surrender—July 26, 1945
Japan rejects—July 28, 1945
Bomb on Hiroshima—August 6, 1945.
Bomb on Nagasaki—August 6, 1945
Russia declares war—August 8, 1945
A H Compton in *Nature*—November 11, 1945
Atlee-Truman-King declaration—November 15, 1945
Lilienthal document—
Baruch Plan—June 13, 1946
Soviet rejects plan and puts counter-plans—
K T Compton Report—May 1947
Finletter Report—January 1948

[1] *B A S , War Dept*

[2] *B A. S* Vol 1, No 9, p 13, 1947.

NOBEL LAUREATE IN PHYSICS

PROFESSOR P M S BLACKETT, F R S, of the University of Manchester is the recipient of Nobel Prize in Physics, this year He is one of the brilliant students of the late Lord Rutherford, who was Director of the Cavendish Laboratory, Cambridge, from 1919-38

In the early stages of his research career, Blackett devoted himself mainly to the perfection of Wilson cloud chamber for study of tracks of α- and β-rays, etc

After the discovery of Cosmic rays by Hess and others, attention of many of the physicists was attracted to this fascinating subject It was Skobelzyn who first observed with his Wilson chamber that tracks of Cosmic rays were of the same type as high speed β-rays As the Cosmic particles are coming from above and as the horizontal Wilson chambers have very little depth in the vertical direction the problem was to set up Wilson chamber in the vertical plane so that the effective length of tracks in the chamber would be sufficiently large for scrutiny Blackett in England and C D Anderson in California took up this problem simultaneously.

Anderson set up his chamber in the vertical plane within a strong electro-magnet such that the magnet current, the expansion of the chamber, the illumination and the exposure etc, were all controlled automatically He expanded his chamber at random and just before each expansion the magnet current was automatically switched on and it was cut off just after the expansion With this arrangement Anderson obtained photographs of tracks of Cosmic particles Efficiency in this method was unfortunately very low, in fact, he obtained one or two measurable tracks per hundred exposures However, Anderson discovered in 1932, with this *randomly* operated chamber the positron, which is the positive counterpart of electron, and a Nobel prize was awarded to him for this work in 1936

Blackett also set up his vertical chamber within a magnetic field at the same time and besides making the chamber operations perfectly automatic and machinised he ingeniously controlled the expansion of the chamber by the coincidence pulse from two Geiger-Muller counters—one placed above the Wilson chamber and the other just below it With this *counter controlled* chamber Blackett obtained beautiful pictures of tracks due to Cosmic rays—the efficiency in this case being about 80 per cent Some of the pictures obtained by him showed for the first time, Cosmic ray showers—large number of tracks originating from a common point or region in the metal parts of his apparatus above the chamber It was shown afterwards that each of these showers contained a large number of positron tracks In fact, the number of positrons and electrons in a shower is almost equal Subsequently these showers were explained by the cascade theory developed independently by Carlson and Oppenheimer in U S A and Heitler and Bhabha in U K

With his Wilson chamber Blackett made further investigations in Cosmic rays and determined their energy spectrum at sea level Last year, he put forward an interesting theory which seeks to explain the origin of magnetism of the sun, stars, as well as of the earth He was made a Fellow of the Royal Society of London in 1933 and was awarded the Royal medal in 1940 for distinguished work Prior to his joining Manchester University as Langworthy Professor of Physics in 1937 he was in Birbeck College, London, for some years

During the war, Professor Blackett was entrusted with the operational researches in England He was a member of the Anderson Committee on Atomic Energy and a member of the Britain's Committee on Scientific Man-Power

Blackett was invited to advise the Government of India on the organisation of science for defence

and spent a few months in India this year in devising plans (See *Science and Culture*, September, 1948, p 112)

Blackett who is now 51 years of age, is the Chairman of the Association of Scientific Workers in England and takes keen interest in the activities of the Association

P C B

ON AN ECONOMICAL METHOD FOR THE PRODUCTION OF CINCHONA ALKALOIDS

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THE process at present in vogue for the manufacture of quinine is based on the extraction of cinchona bark by organic solvents, but the need of a more economical method has long been felt, particularly for treating low grade barks The search for a cheaper method was stimulated during the last war when supplies of quinine from the normal sources were no longer available In India, proposals have been made for the quick production of cinchona bark by adopting a process of cultivation akin to the "Russian method" in which planting is done with close spacing and some of the plants are uprooted when 2, 3 or 4 years old But this would yield cinchona material of low alkaloid content (not more than 2 or 3 per cent) and it would be too costly to extract this by the usual solvent process The success of the whole scheme would depend upon the development of a more economical process of extraction

Another plan to supplement the present meagre output of quinine in this country would be by extracting the cinchona alkaloids contained in the waste fractions of the cinchona tree At the time of harvesting, only the bark is collected and the other parts are thrown away The latter have been found to contain at least 50 per cent of the amount of alkaloids actually recovered from the bark But isolation of the alkaloids from these waste materials presents a still greater difficulty on account of their very low alkaloid contents, which do not exceed 0 5 per cent *

The problem therefore resolves itself into finding a process or processes by which it would be possible to isolate on a commercial basis the total alkaloids from

(*a*) the low alkaloid materials available from young cinchona plants , and

(*b*) the waste fractions of cinchona tree which are still poorer in alkaloids

If the process be found to be convenient and economical, it might ultimately replace the present system of manufacture altogether

THE ACID PROCESS

The acid extraction of cinchona bark has been frequently tried as an alternative method for the isolation of the alkaloids Maraffion and co-workers[1] stated that the total alkaloids can be successfully isolated from low grade cinchona bark by extraction with acid It is however known that not more than 50 per cent of the total alkaloids in cinchona bark can ordinarily be extracted by means of dilute mineral acids For attaining a higher efficiency of extraction, the quantity of acid required would be inordinately large, and since a correspondingly high amount of alkali would be needed for alkalinisation and precipitation of the alkaloids, the cost would become prohibitive

The above difficulty can be obviated if the acid extract be treated with an adsorbent which would retain the alkaloids and regenerate the acid which can be used again It should also be possible to recover the alkaloids from the adsorbent and restore its original activity If this principle can be developed into a continuous and cyclic process, exhaustive extraction of bark can be effected with little consumption of acid and would result in high efficiency and low cost of extraction This has recently been worked out in the U S A under the auspices of the Engineer Board Research Group of the Army and described in a number of publications [2, 3, 4] It appears from these that a "portable unit" has been designed for the extraction of cinchona bark at the site of the stands of cinchona trees, involving the use of a synthetic ion-exchange resin But synthetic ion-exchange resins are not available in this country and a suitable adsorbent, easily available here would be

* These aspects have been discussed more fully in a previous article (see SCIENCE AND CULTURE, March, 1948, pp 372-374)

desirable It is obvious therefore that a process will have to be developed by basic work as well as by pilot plant experiments which would be suited to our conditions and requirements

An investigation has been started in this laboratory for developing an acid extraction *cum* adsorption method for the isolation of cinchona alkaloids, planned on the following lines [5]

(1) To choose a suitable adsorbent This should be easily available in the country, should be able to adsorb alkaloids from acid solutions and should be capable of being eluted free of the alkaloid and restored to the original condition

(2) To choose a suitable solvent This should be an efficient eluent and be capable of being recovered easily after use

(3) To establish the working conditions, including output, efficiency, economy and quality of the production on a laboratory scale and then on pilot plant scale, for each of the different types of raw materials that might have to be employed, *e g* , bark, young plant material or waste materials

(4) To make a design and layout for a large scale extraction plant embodying the results of the investigations

The work done so far has been concerned with the choice of an adsorbent Studies are being made of the characteristics of various adsorbents in respect of the adsorption of quinine under various conditions The materials being studied include activated charcoal (prepared in this laboratory[6] and also from the market), fuller's earth, kaolin of Indian origin (both natural and activated[7]) and bentonites (from Kashmir and Jodhpur) Materials of foreign origin, *e g* , Canadian bentonite (Wyoming) and British kaolin (Cornish) have been studied for comparison Several samples of synthetic cation-exchange resins have been secured from different firms in the U S A and studies with these samples are also in progress

The results so far obtained indicate that activated charcoal possesses the maximum adsorbing power and the one ion-exchange resin which has been tested is much inferior in this respect under the conditions studied The Canadian bentonite comes a close second followed by Kashmir bentonite Indian kaolin is superior to British kaolin, and the adsorbing power is appreciably increased on activating the former Attempts are being made to increase the adsorbing power of Kashmir and Jodhpur bentonites by similar activation

Ghosh and Khan[8] have recently studied the adsorption of quinine by several adsorbents, *e g* , activated charcoal, fuller's earth, kaolin and kieselguhr and concluded that charcoal would be the most suitable for the isolation of the alkaloid They have reported fairly high percentage recovery by elution of the adsorbent with a benzene and amyl alcohol mixture It would be desirable to have information on the percentage recovery of the solvent and any loss in activity of the adsorbent after one cycle of operations is completed, in order to arrive at a conclusion regarding the feasibility of the process

DETAILS OF EXTRACTION WITH ION-EXCHANGE RESIN

In the process as developed[2, 3, 4] at the Rutgers University College of Pharmacy in the U S A , the powdered cinchona bark (or strips of fresh and undried bark) in canvas bags is macerated in 0 1 N sulphuric acid in a tank and the acid extract is passed through a series of exchange columns packed with the resin The alkaloids being retained in the columns, the regenerated acid is recirculated to the maceration tank, and the process runs in a cycle until the bark is exhausted

Caustic soda solution (0 5 N) is then passed through the columns to precipitate the alkaloidal bases and to remove part of the colouring matter retained by the columns This is followed by washing the columns with a little water to remove excess alkali and rinsing the water out with a little alcohol More alcohol is passed to dissolve out the alkaloid Finally, the alcohol is rinsed out with water The alcohol in the extract is recovered by distillation and the alkaloidal residue, which may contain anything between 40 and 80 per cent of alkaloid, is subjected to further purification For this, the alkaloid is dissolved in 1 N hydrochloric acid and the *p*H adjusted to 6 5 when the impurities mostly separate out These are removed by filtration and the *p*H of the solution again adjusted so that the alkaloids are precipitated These are then filtered and dried

The over-all yield of the process is claimed to be about 90 per cent and the purity of the product such as to pass the tests of purity of the official totoquina, although the relative proportions of the different alkaloids would depend upon the original bark

COST OF PRODUCTION

Cost of extraction from bark —The estimate of the cost of extraction of bark by the acid process, given below, is calculated on a tentative basis, in the absence of precise data, and does not include depreciation on equipment

Supposing the plant unit can take a charge of 500 lbs. of bark containing 5 per cent of total alka-

loids, the cost of materials, other than bark, would be, on the present day basis

Item	Quantity	Amount
Sulphuric Acid, C P, sp gr 1 84	2 5 lbs	1 14 0
Hydrochloric Acid, C P, sp gr 1 15	20 lbs	13 12 0
Caustic Soda, flaked	10 lbs	2 1 0
Rectified spirit (duty free) (Assuming 10% loss)	2 gallons	3 8 0
Total		21 3 0

If the efficiency of extraction be taken as 80 per cent, the operation will yield 20 pounds of totaquina The cost of materials for the extraction of each pound of the totaquina would therefore be Re 1-1-0 The cost of adsorbent would be negligibly small as it can be used over a sufficiently large number of operations

Taking the cost of labour and supervision as equal to the cost of materials, and general overhead charges as 25 per cent of the other costs, the total cost of production per pound would be

Cost of materials	Re 1 1 0
Labour and supervision charges	1 1 0
Overhead charges	0 8 6
Total	Rs 2 10 6

This compares favourably with the cost of extraction of quinine sulphate from bark by the solvent process, which has been given by Wilson and Mirchandani[9] as Rs 5-0-0 per pound including overhead charges It should be remembered however that this estimate was based on pre-war rates and would be much higher if recalculated on the present day basis

If we take the cost of one pound of totaquina in the bark as Rs 6-4-0 as has been done by Wilson and Mirchandani[9] for quinine sulphate in the bark, the total cost of one pound of totaquina amounts to Rs 8-14-6 We might however regard Rs 10-0-0 per pound as a round and a more approximate figure, inclusive of the depreciation and certain other minor charges which have been left out of calculation

The above figure might stand comparison with the cost of totaquina, obtained by the acid *cum* ion-exchange process, as given by the American workers[8] on actual production basis, namely $0 0038 per 10 grains which comes to $2 66 (equivalent to about Rs 8-12-0) per pound In a private communication to the author Dr Applezweig revealed that "$0 0038 for 10 grains of totaquina represents the cost of labour, chemicals, equipment depreciation but does not include a value for the cinchona bark" He further explained that "This cost was determined during the war for an army project which processed bark in jungle areas where there was no cost involved for the cinchona" The cost of bark is however an important item under normal plantation conditions, but the cost of transport of the plant and the increased labour and overhead charges inherent in a relatively small portable unit might be obviated by adopting a static and large capacity plant

Cost of extraction from wood—If, however, waste cinchona material, *e g*, wood, containing about 0 5 per cent of total alkaloids be taken in place of the bark, the cost of materials used for extraction would be substantially lower, since the quantities required are mostly dependent upon the quantity of alkaloid adsorbed on the ion-exchange columns The cost of extracting 500 pounds of wood may be calculated as follows

Item	Quantity	Amount
Sulphuric Acid, C P, sp gr 1 84	2 5 lbs	1 14 0
Hydrochloric acid, C P, sp gr 1 15	2 5 lbs	0 5 0
Caustic Soda, flaked	1 5 lbs	1 11 6
Rectified spirit (duty free) (For an yield of 2 pounds totaquina @ 80% efficiency)	0 25 gallons	0 7 0
Total		4 5 6

Since in actual practice, several such extraction units will have to be run simultaneously, in a battery, the labour and supervision costs would not be far beyond the estimate for bark, and may be taken as Rs 2/- per pound of totaquina Taking the overhead charges, as before, as 25 per cent of the other costs, the cost of extraction of totaquina from wood, per pound would be —

Cost of materials	Rs 2 2 9
Labour and supervision	2 0 0
Overhead charges	1 0 9
Total	Rs 5 3 6

Cinchona wood at present has no value but some cost would be involved in transport and grinding From the above calculations it may reasonably be expected that the production of cinchona alkaloids from cinchona wood might not be an unpractical proposition Actual working data would however be necessary to form a more reliable estimate of production costs

Prospects of the Acid-extraction *cum* Ion-exchange Process

The above data would indicate that the acid process of extraction combined with adsorption of the alkaloid is likely to provide a relatively econo-

mical method for the isolation of cinchona alkaloids It has been claimed by the workers[3] in the U S A, who have developed a portable unit of extraction, that the method is quite feasible in large scale work and it has been estimated that 300 such plants would produce 51,600 pounds of totaquina per month, which is the requirement of Latin America A firm in the U S A is actually manufacturing equipments for the extraction and purification of cinchona alkaloids by the ion-exchange method, for which they have applied for a patent A plant handling about 35,000 pounds of fresh cinchona bark would cost in the neighbourhood of $100,000 00 including their services and profit It is very likely that a plant working on similar lines, but adapted to Indian conditions, can be constructed here at a much lower capital cost

A pessimist's view has however been recently expressed by a British quinine authority On a reference being made by the Manufacturing Chemist, Mr Bernard F Howards[10] of Howards & Sons, Ltd of London is said to have stated that he thought this newly developed process would be unlikely to help either the quinine analyst or the manufacturer in any modern factory and further that the product, described as totaquina, would also be unlikely to meet the U S or British pharmacopoeial specifications and would only be a crude febrifuge

It is difficult to express a definite opinion in view of the above, but it may be stated that provided it is really found to be a cheaper method for the isolation of the total alkaloids and the latter are obtained in a fairly pure state, it would serve to provide a cheaper form of cinchona preparation for fighting malaria, and this in itself would be a great advantage for the poor and malaria stricken people of our country Again, if the waste cinchona materials can be treated by this process to obtain even a "crude febrifuge", it would go a great way in relieving the shortage of quinine On the other hand if by further research the process can be adapted for producing at a cheaper rate standardised preparatons of quinine and other alkaloids, it would revolutionise the present system of quinine extraction What is needed is well-planned and systematic work in these directions

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ENZYMIC ACTIVITY IN OPIUM MEASURED BY RESPIRATED CARBON DIOXIDE

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OPIUM, since its exudation from poppy capsules, changes in composition *firstly* due to chemical reactions—(*i*) oxidation and (*ii*) polymerisation, and *secondly* due to biochemical reactions—(*i*) bacteriological, (*ii*) fungal, and (*iii*) enzymic Existing methods for the estimation of any of the prominent active principles contained in this drug do not give as a rule results with sufficient degree of accuracy for observing velocity of change of one or more of its constituents during a reasonably long period Consequently small progress of oxidaton or polymerisation cannot be measured to serve any useful purpose It also contains acidity often more than pH_5, so bacterial growth in such medium is difficult While working in a pharmaceutical laboratory, opium is found to offer in various conditions favourable media for growth of many kinds of fungi It is however not possible to measure all activities of such spores in the substance

Annett[1] isolated oxidising enzymes Considering the view that all anzymes present in the drug are definite organic compounds[2], the problem of isolating each one of them or even more important ones in a state of purity or of increasing concentration for the purpose of studying individual effects on the natural product will be very difficult and elaborate It was consequently thought that it will be useful to measure carbon dioxide respirated by enzymes present in or

outside the cells or spores, which occur in the drug And eventually such measurement of rate of elimination of carbon dioxide would most probably indicate total activities in opium which contribute partially or essentially to velocity of changes in constituents of opium

Natural drugs like opium have to be stored for future use Hence it is necessary to know the progress of change during storage, and to minimise such change if it tends to deteriorate the essential quality of the drug The rate of respirated carbon dioxide is expected to furnish a sensitive method for watching the velocity of reactions Measurements of respirated carbon dioxide in leaves, flowers, and fruits were done by various authors for various objects[3], but the respirated carbon dioxide during storage of opium was not estimated before for the purpose of measuring the activity of enzymes either existing in cells or spores, or existing out of them on account of lysis while still possessing activity

The mechanism of the formation of carbon dioxide in opium is unknown It may be formed at the expense of one or more of organic molecules present in the mass It cannot be said definitely that the atmospheric oxygen takes no part in the phenomenon Although opium was found to be free from traces of inflammable gases like hydrogen or methane, yet it contains occluded oxygen and nitrogen together with carbon dioxide

	Sample	Carbon-dioxide % W/W	Oxygen % W/W	Nitrogen % W/W
1	Standard opium, or Government Excise opium, 1940	0 0350	0 0268	0 0502
2	Do 1941	0 0368	0 0290	0 0512
3	Medical opium powder, 1941	0 0368	0 0114	0 0380

The above sample of medical opium powder was heated to free it from lumps, when it was expected to loose most of its occluded gases, but most probably it absorbed gas again when it was cooled down Therefore its proportion of occluded nitrogen and oxygen was closer to that of atmospheric air Standard Indian opium samples were natural products, which contained these two gases in altered ratio Nitrogen was less in proportion probably due to its conversion in synthesis of nitrogenous compounds found in the drug If any atmospheric oxygen was consumed in the formation of carbon dioxide, then how the activation of such gas molecule took place need theoretical explanation

Measurement of carbon dioxide was done by taking a sample of standard Indian opium (20 gms) in a litte distilling flask Current of air was passed by suction from filter pump at the rate of one bubble per second through a series of 4 gas bottles (300 ml each) on the side of the entrance of air The first gas wash bottle contained 50 per cent w/v caustic potash (100 ml) solution, second and third ones contained each solution (100 ml) of 5 gms of pure crystals of pyrogallic acid in 50 per cent w/v caustic potash, and fourth one contained chemically pure sulphuric acid (100 ml) Air thus freed from carbon dioxide and most part of oxygen, entered in the distilling flask by means of glass tube, which entered through a bored rubber cork fixed to close the flask and to reach just above the surface of opium

Side tube of the distilling flask was connected in series with two more gas wash bottles-fifth and sixth —and then finally to a filter pump Each of these fifth and sixth gas wash bottles contained 2 per cent $Ba(OH)_2$ $8H_2O$ w/v baryta water (100 mol) The sixth gas wash bottle was introduced to ascertain if any carbon dioxide had escaped absorption from the fifth one During the experiment any carbon dioxide respirated from enzymes in the enclosed piece of sample was daily chased out by means of air freed (before entrance) from carbon dioxide and oxygen The decrease in alkalinity of the baryta water using phenolphthalein indicator against 0 1 N hydrochloric acid after passage of air current for the last 5 hours of 24 hours daily, and after removal of barium carbonate, gave the amount of carbon dioxide respirated by the active enzymes present in the sample

Blank experiments were done time to time without opium to show that absorption of carbon dioxide was complete in the above series In each of these blank experiments, there was no sensible loss of alkalinity in barium hydrate solution Results of one of the several samples examined are given below

Days	Maximum room temperature, in 0°C	Weight in gm of carbon dioxide respirated in 24 hours by 20 gms of opium with about 10% natural moisture after sun drying
1	32	0 0001056
2	32	0 0001056
3	33	0 0001056
4	33	0 0001058
5	32	0 0001008
6	32	0 0001055
7	32	0 0001056

Dunnicliff and co-workers[4] dried at 50°C a few unusual samples of Indian opium and observed much loss of morphine strength during storage of 2 years Based on the results obtained with these peculiar samples they declared a broad generalisation "opium dried at 60°C stored in contact with air suffers a rapid loss of morphine" Our results do not confirm them.

Excise opium or standard opium, medical opium cake, medical opium powder as sold by the factory at Ghazipur, all maintain reasonably uniform morphine strength 9 5 to 10 5 per cent in dry weather during one or two years after issue from the factory, when tested by B P 1932 method These authors also oxidised morphine with potassium cupro-cyanide and isolated a product negligibly soluble in lime water, which they assumed to be pseudo-morphine It is well known that pseudo-morphine is soluble in ammonia and caustic alkali [5] The fact that the product was negligibly soluble in water naturally creates a doubt about absence of phenolic hydroxyl characteristic to morphine structure It is hardly correct to call the product pseudo-morphine These authors also did not isolate from their samples of opium pseudo-morphine or anything, identical with their product of oxidation of morphine Yet they concluded that the quantity of morphine, found short by them in the subsequent estimations by B P process, was converted into a product, by the action of oxidising enzymes naturally present in opium, which was the same as that of theirs

Loss of morphine strength in opium during storage is an important subject And measurement of carbon dioxide seems to be useful in watching the phenomenon under different stages, from its exudation out of poppy capsules till the drug is issued out of the factory or till it is consumed in other manufacturing processes At present the author have observed that average Indian opium alter in composition very slowly after first few months of collection Suggestion of sage[6] that ammonia content increases with age, need careful consideration in view of the fact that morphine or some such base had to be broken up to give out carbon dioxide and theory eliminating ammonia or simple amines

The author expresses thanks to Messrs Calcutta Chemical Co , Ltd , for permission to publish this paper

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FISH REFRIGERATION

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INDIA is surrounded on three sides by the oceans India's coastal length is 3200 miles The oceans surrounding India abound in fish Fish may be regarded as one of the many natural resources But uptil now no serious attempt has been made to tap this source U S A , Japan, Russia and other countries are trying to develop the deep sea fishing industry The figures available for U S A show that the amount of salt-water fish frozen in 1945 was estimated at 241,980,535 lbs or 121000 tons nearly Another equal amount of salt water fish was sold as fresh Thus 240,000 tons of salt water fish was caught in 1945 This amount must have increased by this time England has also realised the importance of fish industry and "a vast system of regional fish quick-freezing, cold storage, processing and packing centres located at regional ports all around the coast of Britain, is visualized by Mr J J Robertson, Under-Secretary of State for Scotland and M P" Mr Robertson is in favour of nationalisation of the marketing end of fishing, leaving the catching end to the fishermen The author is optimistic, of the possibility of developing fish industry in India In the beginning we might not resort to fish freezing as this requires elaborate refrigerated transport facilities, refrigerated display cases for selling and refrigerators at consumers' houses In this article the author has shown how the industry can be developed in this country even without going for freezing for the present The story of frozen fish would be taken up in a later article

Before mentioning the requirements for developing this industry let us know about the criteria of quality of fish The criteria are given in Table 1

We all know that fish mixed with ice comes from Goalando and other East Bengal towns to Calcutta and is sold as fresh in Calcutta markets but very few of us know that fish if properly refrigerated can be preserved as fresh for several months Fish can be preserved for 8 to 10 months when frozen In this article the author would tell about short storage say

for 20 days It is to be remembered that refrigeration cannot make stale fish fresh but can keep fresh fish fresh for some time Refrigeration retards the multiplication of bacteria responsible for

TABLE I

Strictly fresh fish	Stale fish
1 Odour of fish, fishy	1 Odour stale, sour or putrid
2 Eyes bright, not wrinkled or sunken	2 Eyes dull, wrinkled or sunken
3 Gills bright red, covered with clear slime, odour under gill covers fresh fishy	3 Gills dull brown or gray, slime cloudy, odour under gill covers sour and offensive
4 Colours bright	4 Colours faded
5 Flesh firm, in quite fresh fish the body is stiff, impressions made by fingers do not remain, slime present and clear	5 Flesh soft and flabby, impressions made by fingers remain
6 Belly walls intact	6 Belly walls often ruptured, viscera protruding
7 Muscle tissue white	7 Muscle tissue becomes pinkish, especially around backbone
8 The vent is pink, not protruding	8 The vent is brown protruding

decay So refrigeration is required from the very moment the fish is caught till it is cooked In order to develop the deep sea fishing we are to remember the following points —

I Fish can be preserved from 5 to 20 days when stored at a temperature between 30°F and 40°F

II Fish should be refrigerated on the boats as they are dumped from the net

III Refrigerated transport facilities should be there to take the fish from the docks to the storage plant

IV Facilities for storing the fish at the plant if there be any left over

1 The higher the temperature the lower the storage period In order to preserve for the maximum number of days the fish should be refrigerated to the lowest temperature available as soon as they are caught

II Then comes the problem of refrigerating the cargo space of the boat The most common method is to use ice Recent advancement in refrigerating the cargo space is to use refrigeration machineries But in our country we can use ice in the beginning as the use of refrigerating machineries demand more capital Moreover, an ice plant is essential for the successful carrying and distribution of fish When ice is used the general practice is that the boats leave the shore loaded with ice Generally the boat leaves the shore with an amount of ice equal to the amount of fish that the boat can handle or in other words if a boat can carry one ton of fish it leaves the shore with one ton of ice The ice is sufficient for a round trip in 3 days If the number of days to make a round trip is more than 3 days then an amount of 400 lbs of more ice is to be taken for each day in excess of 3 days The limitation to this method is that the boat must return in 3 days whether or not bringing in a real pay catch

The use of refrigeration machineries is costly but it has got several advantages over the use of ice method The main points in favour of mechanical refrigeration are

1 The boats can remain on sea for any length of time It is not necessary to return until a real pay catch is made
2 The ice is expensive compared to the running cost of a refrigeration machine
3 The handling of ice takes time and labour that can be saved altogether
4 The cost of carrying the ice is more than the cost of carrying the refrigeration equipment

The points in favour of ice system are

1 It is simple and straightforward
2 No specialised refrigeration mechanic is necessary for the service of the equipment
3 Ice plant is absolutely necessary for the distribution of fish so the ice plant can be run at a profit if ice is used for the cargo space

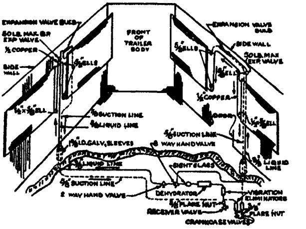
Methods to refrigerate the Fish in Boat

When ice is used alternate layers of fish and crushed ice are to be put in bins The bins are placed in well insulated hold of the boat The thickness of the insulation should be a minimum of 6" of cork or its equivalent The ice should be crushed in such a way that the crushed ice is without sharp corners Sharp corners might cause bruises and the fish would lose the so-called "sales-appeal"

When mechanical refrigeration is used the recommended practice is to spray chilled brine over the fish contained in an insulated tank The brine is being recirculated and cooled in another chamber with the help of a condensing unit driven by a diesel engine

III A small fleet of refrigerated truck is absolutely necessary to truck the fish from the dock to the storage plant which may be situated some 20 to 30 miles from the dock The same trucks may be used to deliver ice from the storage plan to the cargo boats The bodies of the truck are generally insulated with 4" cork or its equivalent and carry

around a temperature of 40°F which is produced by "Dole-plates" or "Holdover plates" These trucks might be provided with separate condensing units which are plugged to the electric main at night in the garage The condensing unit brings down the temperature of the plates down to 25°-30°F and the plates hold enough refrigeration to maintain a temperature of 40°F inside the truck for 8 to 10 hours Another method is to hook up the cooling plant of the storage room to, or to recirculate cold brine from the ice tank through, the "Dole-plates" Fig 1



LAY-OUT OF DOLE PLATES MOUNTED ON WALLS FOR A REFRIGERATED TRAILER BODY

FIG. 1.

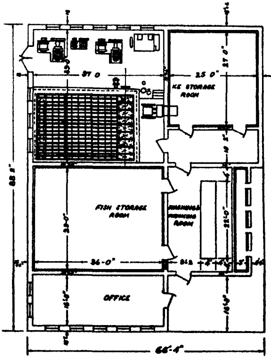
IV When the fish is brought to the fish plant the fish is dumped through chutes into a tank containing refrigerated water The fish is to be washed in water and the water should be changed quite often otherwise the fish is liable to be contaminated if dirty water is used In practice the fish is to be washed in flowing clean water The water temperature is to be maintained at 36°F The fish after being washed is heaped on the sorting and weighing table Here the fish is sorted, weighed and kept in bins putting alternate layers of some fish and ice The local merchants take away some of the bins and some are kept in the storage room to be picked up by merchants later on The storage room should be large enough to hold a few days' catch This would help in preserving successfully the surplus that cannot be consumed in local market

Requirements of a daily catch of 6-ton sea-fish with a 60-ton Storage Capacity

Assume the plant has 2 docks handling 3 boats each. Each boat brings in one ton of fish making a total daily catch of 6 tons of fish Allowing for expansion of the business upto 9 tons daily *i.e.*, 50% increase let us consider the cost of a plant capable of handling 9 tons of fish daily Because of simplicity let us use the ice method in refrigerating the fish in boat

In considering the icing of boats we would require 9 tons of ice In addition to this we would require another 9 tons of ice for the fish sold to the merchants This gives a total of 18 tons of ice daily which means an ice plant of 18 to 20 tons capacity daily

The layout of a plant capable of handling 6 tons of fish daily is shown in Fig 2



LAY-OUT OF A 20-TON ICE PLANT AND A 60 TON FISH STORAGE WITH ACCOMPANYING OFFICE WASHING & SORTING ROOM

FIG 2

Number of boats required	6
Number of refrigerated trucks required, 5-tons	4
Ice Plant	18 tons capacity daily
Refrigeration machineries for storage room and trucks	
Suitable building	

Cost of Ice Plant and Refrigeration Accessories

Ice Plant 18 tons daily capacity	Rs 1,96,000/- approx
Other Refrigeration Machineries and Accessories	,, 1,00,000/- ,,

Conclusion

People of Bengal is hearing from a long time that Government of West Bengal intend to undertake sea fishing Recently we heard about the fishing rights near the Andaman Islands to be acquired by West

Bengal Government We hear of big talks but nothing has been done to remove the fish-famine

We understand that the Government of West Bengal purchased the Brooklyn Cold Storage and Ice Factory situated near Kidderpore from U S Army and uptil now no attempt has been made to utilize it efficiently The ice manufactured there is sold at a nominal rate to an outsider and the entire set up is now a liability If the machines are kept idle for some time more the machines would be all junk If a little thought is given the ice factory and cold storage can be utilized for sea fishing Hope the authorities would move a little and do something tangible to bring down the price of fish A little thought, co-ordination and planning would save public money

INDIAN ASSOCIATION FOR THE CULTIVATION OF SCIENCE

THE foundation stone of new laboratories of India's oldest and pioneer Scientific Association, to be situated at Jadavpur, 3 miles away from Calcutta, in ideal rural surroundings, was laid on Sunday, September 26 last

Laying the foundation of the new buildings Hon'ble Dr B C Roy, Premier, Government of West Bengal said that in 1876 Dr Mahendra Lal Sircar, one of the doyens of the medical profession founded it with the objective that there should be an institution for the instruction of the masses where lectures on scientific subjects would be systematically delivered and not only illustrative experiments performed by the lecturer but the audience should be invited and taught to perform these themselves It was a strange coincidence that when Benjamin Thompson founded the Royal Institution of Great Britain in 1799, Dr Sircar was also actuated by almost identical idealism Men like Davy, Faraday, and Tyndall worked in the Royal Institution in Great Britain and in this country they had men like Dr Mahendra Lal Sircar, Dr Sir J C Bose, Sir C V Raman, Dr Krishnan and others who had obtained international reputation in scientific teaching and research working in this institution Professor Raman was one of the pioneers of research activities as far back as 1907 From time to time research had been carried on "Interference and diffraction of light, Birefringence due to Electric and Magnetic fields, Viscous Flow and Stress and on Magnetic susceptibilities of gases, liquids and solids " Such research work led to what was now known as the wonderful discovery of "Raman Effect" in Physics

The Committee of Management of the Association realised the supreme need of reorganising the activities of the Association so that it might play an increasingly important part in the domain of fundamental researches in molecular physics, a branch of science in which it had made a name and had a tradition to cherish The Planning Committee recognised the new trends and tendencies of scientific research The plan ultimately envisaged in 1947 the creation of an active Research School where the problem of molecular structures would be investigated by the concerted team work of a band of physicists and chemists

"Our statesmen and scientists", Dr Roy continued, "have begun to realise that if India is to take her rightful place in the Assembly of Nations it is highly necessary for her to undertake an intensive programme of simultaneous and co-ordinated development of both fundamental and applied research It is now recognised that such researches alone can ensure the security of a country in war and its prosperity in peace It is hoped that India will inaugurate a new era where fundamental and industrial researches will be harnessed for the service of her people "

"I am laying this foundation stone in the hope,' Dr Roy concluded, "that we shall soon realise our dream, namely, integration of science and industry and placing science to the service of mankind and its welfare "

Dr M N Saha, President of the Association, while welcoming the guests, said that the two great wars appeared to have brought the realisation of the usefulness of science for human well-being to the people and statesmen of the world, and taking advantage of this feeling, the Council of the Association had worked out a new expanded programme for its activity In this programme attempts had been made to retain the traditions of fundamental research in the Association, but a programme of activity had been added to it, namely, industrial research growing out of these fundamental researches

This scheme had been accepted by India Government who increased its grant from Rs 20,000 to Rs 2,66,700 and given the Association a capital grant of Rs 4,32,000 for building purposes Government of India had also given an interest-free loan of Rs. 5

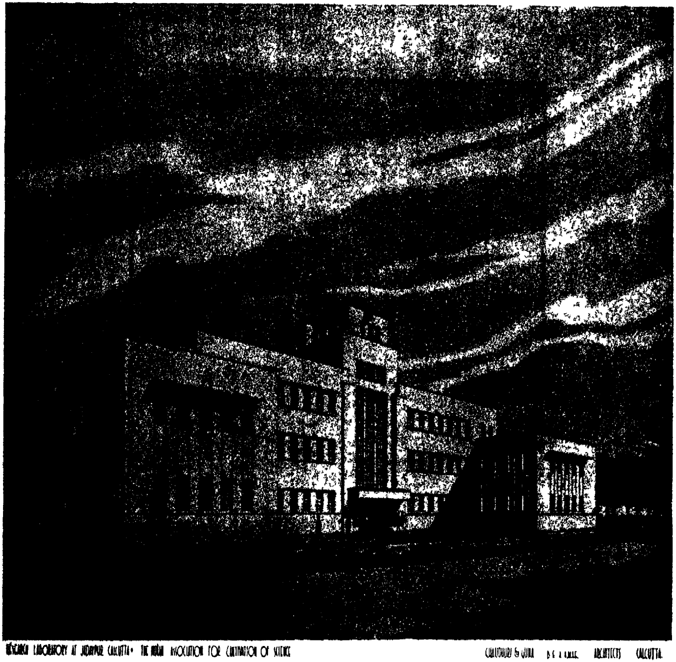
lakhs with which the site at Jadavpur was acquired through the good offices of the provincial Government With the increase in the cost of materials and labour the original estimates had jumped from Rs 18,64,000 to nearly Rs 33 lakhs and so far promise of Rs 9,32,000 had been obtained from Central Government of which Rs 5 lakhs had already been paid It was necessary to raise nearly Rs 24 lakhs the scheme and a further substantial amount for laboratory equipments and fittings

Under the new scheme six departments are proposed to be opened by the Council of the Association namely (1) X-rays and Magnetism, (2) Optics, (3) Theoretical Physics, (4) Physical Chemistry, (5) Organic Chemistry and (6) Inorganic Chemistry

DR MAHENDRA LAL SIRCAR

for the completion of the scheme West Bengal Government had promised to bear one-fourth of the total cost and Professor Saha hoped that 7 to 8 lakhs of rupees could be raised from the sale of Bowbazar properties of the Association, in case the Council was forced to do so In that case the Council would have to raise another nine lakhs of rupees to complete

Each department will be under a professor or reader and to assist him there will be one research officer and one laboratory technician Initially there will be one senior research scholar and two junior research scholars in each department, but the strength of scholars in each department might be increased in near future.



PLAN FOR THE NEW BUILDINGS OF THE INDIAN ASSOCIATION FOR THE CULTIVATION OF SCIENCE AT JADAVPUR NEAR CALCUTTA

Notes and News

OBITUARIES

SARATLAL BISWAS (1888-1948)

It is with deep regret that we record the sad demise of Professor Sarat Lal Biswas, formerly Lecturer-in-charge of the Geology Department of the Calcutta University at the age of about 60 on the 18th July last Professor Biswas had retired in July 1947 owing to continued ill health after serving the University for nearly 30 years He was specially interested in Crystallography, Mineralogy and Petrology in each of which subjects he made original contributions His main contribution was to the controversial subject of the origin of the mica-bearing pegmatite rocks of Koderma in Bihar and Nellore in the Madras Presidency Above all he will be remembered for his inspiring teaching, his recognition of talent, and his guidance of the research work of several students who have distinguished themselves in their special fields Professor Biswas was an ideal teacher of a rare type having an abundance of human sympathy which earned the respect and admiration of all who came in contact with him

May his soul rest in peace !

RAMENDRANATH GHOSH (1906 1948)

By the premature death of Dr R N Ghosh, who expired on November 2 last at the Prince of Wales Medical College Hospitals, after a brief illness, Calcutta has lost a young surgeon of great repute and who was held in high esteem as a scholarly teacher, clinician and lecturer

Born in 1906, Dr Ghosh was the third son of the late Rai Bahadur D N Ghosh, the first Indian Director of Statistics and Commercial Intelligence, Government of India Educated at the Scottish Church Collegiate School, Calcutta where he was a prizeman, he joined the Calcutta Medical College in 1923, of which he was a college scholar throughout his career and took his M B degree in 1929 with certificates of Honours in Pharmacology and Pathology

After serving as a Junior and Senior House Surgeon of Medical College Hospitals for some years he proceeded abroad and was duly elected a Fellow of the Royal College of Surgeons, Edinburgh, in 1934 Thereafter he had his training in London at the Lock Medical and St Paul's Hospitals. After his return from U K he became a Junior Visiting Surgeon of the Calcutta Medical College and soon made his mark and became the First Honorary Additional Surgeon and officiated for sometime as Professor of Clinical and Operative Surgery He was also a Visiting Surgeon of the Calcutta Medical School and Associate Professor of Anatomy, National Medical College, Calcutta He was offered other responsible posts but he was not spared from Calcutta, where his services on the higher posts were often in requisition

Dr Ghosh was an Ordinary Fellow and a member of the Faculty of Medicine of the Calcutta University Amidst all these heavy responsibilities Dr Ghosh had keen instinct for research and published a number of important papers in various medical journals

He was snatched away in the very prime of life to the great loss of the student community, and the suffering public, and leaves behind besides his widow (third daughter of the Hon'ble Mr Justice C C Biswas of the Calcutta High Court), and a child, a host of friends and relations to mourn his premature death We offer our sincerest condolences to the members of the bereaved family

PAUL LANGEVIN—JEAN PERRIN

During the World War II, while the French were under German occupation, a number of scientists died under tragic circumstances Dr Jean Perrin, famous for his classic experiments on Brownian movement, died as exile in the U S A Prof Langevin was in the Refugee Camp on account of his well-known social activities He suffered personal bereavement in the murder of his son-in-law and though he survived the War, he died early afterwards It is in the fitness of things that the French Government had decided to remove the mortal remains of two of their greatest scientists to the National Resting Place for the French Immortals, the Pantheon In this connection they had arranged a number of debates and meetings in November last as given below

15th November

Morning Large Molecules in Solution Mr Faure-Fremiet in the chair

Evening Solemn meeting in the Grand Amphitheatre of the Sorbonne (47, rue des Ecoles) The Minister for Education in the Chair.

16th November

Morning Cryo-Magnetic Phenomena Mr Aime Cotton in the chair

Evening Vigil in the Palais de in Decouverte (Avenue F D Roosevelt)

17th November

Morning Removal of the mortal remains of P Langevin and J Perrin from the Palais de la Decouverte to the Pantheon

Evening The Organisation of Scientific Research Mr J D Bernal in the chair

18th November

Morning Atomic Rays and Structure Mr Maurice de Broglie in the chair

Evening The Organisation of Scientific Research Mr F Joliot-Curie in the chair

19th November

X-Rays and Atomic Structure Mr Maurice de Broglie in the chair

A SOLAR FURNACE

THE temperatures involved in melting some of the metallic oxides range from 2000°C upwards, and it now appears that the production of such high temperatures presents a most promising field for the direct utilisation of solar energy The average solar energy reaching ground level may be taken roughly as 0 08 watts per square centimetre By means of parabolic mirrors this energy can be concentrated to about 50,000 times, giving some 4,000 watts per square centimetre It can easily be shown that energy falling on a black body at this rate would raise its temperature to over 5,000°C If this energy is being used to melt a substance or promote a chemical reaction, the efficiency will be about 70 per cent whereas in using heat energy to produce mechanical power, the ideal is about 35 per cent and the figure actually attained in solar steam engines is some 5 to 10 per cent

In 1946, a solar furnace was set up at the Meudon Observatory near Paris, making use of mirrors of 2 metres diameter and 85 centimetre focal length With these mirrors temperatures of about 5,000°C should be obtainable In a test, the sun's rays were concentrated on graphite, and a pyrometer recorded a temperature of over 3,500°C, but at that temperature the graphite was sublimina In other words the supply of energy was enough to provide a high temperature, but the sublimation kept it down to 3,500°C

Investigations have also been made on the possibilities of using the furnace for the synthesis of nitric oxide The synthesis of nitric oxide is a first step towards producing nitrate fertilisers from the atmosphere If a mixture of nitrogen and oxygen is raised to a high temperature, some molecules of nitrogen and oxygen will always be combining to form nitric oxide, while some nitric oxide molecules will be breaking down again into oxygen and hvdrogen At each temperature an equilibrium is reached, such that a certain percentage of the mixture consists of nitric oxide The higher the temperature, the more nitric oxide Thus at 3,000°C, the mixture contains about 95 per cent nitrogen and oxygen, and 5 per cent nitric oxide In two commercial processes a mixture of oxygen and nitrogen (in fact, atmospheric air) is blown through an electric arc, which raises the temperature and produces a just proportion of nitric oxide The gas mixture is then quickly cooled to prevent the nitric oxide from breaking up again (as it would with slow cooling) The experiment has been tried of substituting the solar furnace for the electric arc The results obtained were not so good as for the arc processes, but it is hoped that the new process might be economically more successful with an improved apparatus (*Discovery*, October, 1948)

TURBINE DEVELOPMENTS IN RUSSIA

In March, 1947, an All-Union Conference on Steam Turbine Technique was held at Leningrad Reference was made to the 100,000 KW steam turbine running at 3,000 r p m with initial steam conditions of 90 atmospheres at 480 deg C built by the Leningrad Works "Stalin" Future work includes the development of topping turbines for steam conditions of 175 atm and 550-600 deg C The Economizer Works are reported to be engaged on the design of high pressure turbines for centrifugal boiler feeders with initial steam conditions of 90 atm at 480 deg C and a back pressure of 1 2-2 5 atm Turbine capacity is 1,350 KW and its efficiency at the coupling is 70 per cent

The report also states that at the Central Boiler and Turbine Institute a new aerodynamic test plant equipped with optical instruments of the Toepler type was installed A larger aero-dynamic wind tunnel plant is being erected at that institute which will include an air compressor capable of delivering 30,000 cu m of air per hour at 7 atm pressure Methods for the computation of turbine blade profiles are being developed and investigations into erosion and corrosion in the last turbine stages are being made

At the same institute important work on gas turbines is in progress and the characteristics of both open-cycle and closed-cycle types have been studied A single stage axial compressor was installed in 1946 and a first series of tests was run Experiments aiming at the development of a three stage axial compressor are under way and an experimental single stage gas turbine is being built At the laboratory of the institute the fatigue strength and the creep properties of turbine materials at 800 deg C are also being investigated

The preliminary layouts of two mercury-steam plants were completed in 1946 The first of these projects is a 4,000 KW mercury turbine to form part of a 10,000 KW mercury-steam plant This is to be installed at the Central Boiler and Turbine Institute Mercury vapour will be generated at 10 atm and 515 deg C, and the overall plant efficiency is estimated at 40 per cent The second mercury-steam plant is intended for the driving of blast furnace blowers, and the exhaust mercury vapour is to be used for heating the blast (*Kotloturbostroenie*, Russia, No 3, 1947, *pp 28-29*)

THEORY OF ELASTO-VISCOUS BODIES

A theory governing the properties of elasto-viscous materials, ranging from the hydrodynamics of viscous materials on one hand to the theory of elasticity on the other has been developed in Russia and presented in an interesting paper by A I Gubanov Developed from Frenkel's Kinetic theory of Fluids (*Acad of Sc, Pub U S S R*, 1945, *Chap 4*) corresponding equations are obtained by substituting for the shear modulus (in the elastic theory) an operator for the coefficient of viscosity and reaction of time On this basis the cases of elastic shear, torsion and tension are generalized It is shown that the typical elasto-viscous properties appear only in periodic or nonstationary ragimes, as under stationary conditions simple viscous behaviour is obtained

Detailed investigations are carried out for (*a*) shear in an infinite layer of finite thickness under imposed forces and displacements and tangential impact, (*b*) torsion of a cylindrical rod under imposed displacements and forces and (*c*) uniform tension Complex as is the theory in its mathematical form its practical applications cover a very wide range of problems in pure and applied science Thus it is applicable in soil mechanics to the theory of the behaviour of a soil layer under shear, and to that of heated glass in various forming processes. It also finds use in the field of polymers, and plastics; in geology, geophysics and astrophysics and in the investigation of motion in highly viscous media (*zh tekh Fiz Russia, 17,* 475-490, 1947)

MINIATURE NEUTRON GENERATOR

A miniature neutron generator, which is safe and cheap enough for use in college laboratories has been developed in the United States The dangers inherent in radioactivity research are virtually eliminated by using a speck of radium, less than 1/500 oz In the University of Notre Dame, students have used a small amount of a mixture of the elements radium and beryllium and produced radioactive isotopes It is reported that good results have been obtained in irradiating normal iodine and bromine with neutrons from the generator Three radioactive isotopes, iodine-128, bromine-80, and bromine-82 are produced (*The Chemical Age*, October 23, 1948)

NEW RADIOISOTOPES AVAILABLE

Two new radioisotopes, hydrogen-3 and helium-3 are available to scientists and research institutions in limited quantities from the U S Atomic Energy Commission Hydrogen-3, also called tritium, is a radioactive gas with a half life of approximately 12 years Tritium, when combined with oxygen, can also be used as the valuable research tool known as heavy water Tritium being the only radioisotope of hydrogen will be of special value as a tracer in medical, biological and chemical research Helium-3 a stable isotope, is only one millionth as abundant in nature as ordinary helium Tritium is isolated after the bombardment of a lithium compound by slow neutrons in a nuclear chain-reacting pile, and helium-3 is obtained as the end product of the decay of the radioactive tritium (*The Chemical Age*, October 16, 1948)

NEW URANIUM SOURCE IN U S A

A MINERAL has been found in the rock fissures of the katanga mines, in the Belgian Congo, which contains 60 per cent uranium, 15-20 per cent vanadium, and 10-15 per cent copper It is described "as a hydrous copper-uranium-vanadium mineral", similar to Carnotite—except that carnotite is a potassium not a copper uranium mineral The discovery of the new mineral is considered to be of great strategic value

DUCTILE TITANIUM

DUCTILE titanium has recently been developed on a pilot plant scale by the U S Bureau of Mines, Formerly, it had been produced only on a laboratory

scale by methods that were not suitable for large-scale commercial production Titanium sheet, rod, and wire products are now being fabricated by powder metallurgy methods

Titanium ranks ninth in abundance of all the elements in the earth's crust It has a specific gravity of 4 5 as compared to 7 86 for iron Pure titanium can be processed to have properties comparable with medium strength steels It has corrosion-resistant properties similar to those of 18-8 stainless steel When heated, titanium reacts chemically with hydrogen, oxygen, and nitrogen and becomes brittle The brittle character of impure titanium does not permit shaping To avoid the absorption of gases titanium powder is pressed and then sintered in vacuum By means of cold or hot working procedures with vacuum anneals at various stages of working, sintered titanium is successfully shaped into ductile sheet and wire (*Journal of Chemical Education, September,* 1948)

PENICILLIN S ACTION

EVIDENCE that penicillin attacks germs in much the same way that soap attacks dirt has been reported to the American Chemical Society Recent research in the Massachusetts Institute of Technology, had shown that when a penicillin solution was added to a bacterial culture under the proper conditions the drug coated the individual bacterial cells Soap removes dirt by coating each particle and floating it away Ultramicroscopic investigations revealed that the penicillin solutions were not true solutions, such as ordinary salts yield, but colloidal solutions From the study of their surface tension, it was proved that penicillin salts, when put into solution, form a colloidal solution which will wet a surface just as soaps do The penicillin salts also carry an electrical charge, as soaps do, and therefore have the tendency to cling to surfaces with an opposite charge It has been visually demonstrated by means of ultra-violet light microscopy that penicillin coats bacterial cells, just as soap coats oil droplets in an oil-in-water emulsion (*The Chemical Age,* October 9, 1948)

A DRUG FOR LEPROSY

The British drug, Sulphetrone, (tetra-sodium 4 4′ bis-γ-phenylpropylamino)-diphenyl-sulphone-α-γ-α′-γ′-tetrasulphonate, is now being used increasingly in the fight against leprosy Sulphetrone has a high molecular weight 892 5, and is prepared in the form of a white amorphous power which is very soluble in cold water but insoluble in alcohol and other organic solvents. The stronger water-solutions (60 per cent) are stable when neutral or slightly alkaline and can be treated in an autoclave Weaker solutions are not so stable and the drug is not at present issued in solution form

The estimation of the number of lepers in the world varies between two and five millions , actual figure is very difficult to obtain for the disease occurs chiefly in countries where the collection of statistics of any sort is non-existent Organised treatment of the disease of leprosy is quite often left to be carried out by voluntary religious bodies, by whom the question of available funds has to be taken into account Dosage of this drug also varies Between two to four pounds a year has been found to be the average quantity needed for the treatment of a patient The drug is already being exported to the sterling areas (*The Chemical Age, 59,* 444, 1948)

F 4110—A NEW ALUMINIUM ALLOY

THE aluminium department of the Federated Division of the American Smelting and Refining Co , New York recently developed a new economical die-casting alloy made of copper, silicon and aluminium which had overcome the problems of drilling, tapping and machine casting made from other alloys The new alloy is known as F-4110, under a nomenclature of the Federated Metal Division The name means 4 per cent copper, 11 per cent silicon and no magnesium The alloy has high tensile strength, yield strength, proportional limit and high hardness (*The Chemical Age, 59,* 356, 1948)

ELECTRON LINEAR ACCELERATOR

AN electron linear accelerator capable of hurling particles with a billion electron volts of energy is under construction at Stanford University It is expected that this projected 160-foot accelerator will develop at least three times as much energy as the massive cyclotron at the University of California By extending the length of the slender accelerator tube and by developing power sources 100 times as potent as those used in radar, it may be possible to bombard the heart of the atom with a stream of billion-volt electrons It is also said that the accelerator may produce an artificial source of radiation comparable to Cosmic rays (*Chemical & Engineering News,* September 13, 1948)

WORLD CONSUMPTION OF JUTE

This pamphlet is the second issue of the bulletin published in 1941 dealing with the trend of world consumption of jute between 1933-34-1944-45 It has been determined by the two usual methods of estima-

tion The village consumption of jute is estimated at 6 lakhs of bales by random sampling method

The world position of jute under separate items such as world consumption, and exports of raw jute and jute goods, production of Indian jute mills, purchase of raw jute by Indian mills, mill stocks of raw jute and jute goods, supply and distribution of jute, etc has been discussed Special attention has been paid to some of the above items by the illustration of a few diagrams and a number of tables There is an appendix of six tables showing in details the Indian exports of raw jute and jute goods to different parts of the world

The pamphlet reveals the following important point (*i*) The average world consumption of jute in the pre-war period was 110 lakhs of bales while in the war period it was reduced to 87 lakhs (*ii*) The foreign consumption of raw jute and jute goods in the pre-war days was 84 per cent of the total while Indian consumption was only 16 per cent of the total, though India (united) produced 99 per cent of the world's jute Foreign consumption during war declined by a third of its pre-war average, but Indian consumption rose by 50 per cent (*iii*) The whole of Europe takes 77 per cent of India's total exports of raw jute while the whole of America takes 44 per cent of the total exports of jute goods (*iv*) The largest consumers of raw jute are the Indian jute mills the average annual consumption of which was 57 per cent of the total consumption in the pre-war period and 75 per cent in the war period

The production and consumption of jute separately for Indian Union and Pakistan in the partitioned India have not been shown here (*Economic Research Memoir*, No 1, Indian Central Jute Committee, 1948)

UNIVERSITIES COMMISSION

THE Government of India has appointed a Commission for the purpose of enquiring into and reporting on the condition and prospects of University education and of advanced research in India and of recommending a constructive policy in relation to the problems they present and to the needs of the country The commission would recommend in what direction the existing system of education should be changed in order to meet the requirements of the new set-up of India after the attainment of independence.

The personnel of the Commission will be as follows Dr Sarvapalli Radhakrishnan (*Chairman*), Dr Tara Chand, Secretary of the Ministry of Education, Government of India, Dr J. E. Duff, Vice-Chancellor, Durham University, Dr J J. Tigert, formerly President, Florida University (U S A), Dr Zakir Hussain, *Jamia Milia*, Delhi and Vice-chancellor, Aligarh University, Mr A H Morgan, First Chairman of the Tennessee Valley Authority, Dr Lakshmanaswamy Mudaliar, Vice-chancellor, Madras University, Prof Meghnad Saha, President, Council of Post-graduate teaching in Science, Calcutta University, and Prof K N Bahl, Professor of Zoology, Lucknow University Prof N K Siddhanta, Secretary, Inter-University Board, India, will act as *Secretary*

The members of the commission will meet at Delhi on December 6 and decide on their programme of work, and will meet in Calcutta on January 12, 1949 The report of the Commission is likely to be completed by the end of April, 1949

It may be recalled that the system of University education in general now prevailing in India is governed by the Indian Universities Act, 1904 The act followed the recommendations of a Commission appointed by Lord Curzon's Government, in 1902

INSTITUTE OF PALEOBOTANY

PROF B SAHNI has established an Institute of Paleobotany at Lucknow which he has endowed with all of his personal and real property The institute is located on the University Road, Lucknow in a very fine building given by the U P Government The Government of India has undertaken to help the institute by grants for initial equipment and recurring charges

The institute has as its aim the advancement of the science of Fossil Botany in the widest sense, both in its academic aspects and its application to problems of economic geology The institute has at present under its auspices a scheme for the Measurement of Geological Time, sponsored by the Council of Scientific and Industrial Research of the Government of India Besides devoting itself to original work the institute has planned to train students in methods of research Provision has been made to award promising workers financial aid in the form of stipends, scholarships, travelling fellowships etc The institute will have a wide international outlook and will strive to promote cultural contacts with other countries through an exchange of students and by inviting foreign scholars as visiting professors The institute has also as its aim the publication of a *Journal of Paleobotany*

Prof. Sahni, is the Founder Director of the Institute, and was deputed last year by the Government of India to make a tour of research laboratories in Europe and the U S A with a view to collect ideas about their working and establishments He returned to India in September last.

NOBEL PRIZE IN CHEMISTRY AND PHYSIOLOGY AND MEDICINE

THE Nobel Prize in Chemistry for 1948 was awarded to Prof Arne Tiselius of Uppsala University, Sweden, for 'the discovery of a method of measuring molecules in albumen'

The Nobel Prize in Physiology and Medicine for 1948 was awarded to Dr Paul Muller, the Swiss scientist for his discovery of DDT

ANNOUNCEMENTS

DR H K ACHARYA, Sir Taraknath Palit Foreign Scholar, Calcutta University, has returned after completing higher studies on electron optics and colloid chemistry in Canada, U K, and U S A

Sri H K Chatterji, Senior Research Chemist, Indian Central Jute Committee has been elected a Fellow of the Royal Institute of Chemistry of Great Britain and Ireland

Sri P N Nandi, Adair Dutt Research Scholar, Indian Science News Association, obtained the Ph D degree of the London University for his work on Microbiology He worked at the Imperial College of Science and Technology, London and submitted a thesis on "The influence of antibiotics on micro-organisms in soil"

Dr B Chatterjee has recently returned from Wisconsin, Missouri and Cornell in U S A where he carried out physico-chemical studies with mineral membrane electrodes and specialised in modern techniques of soil chemistry, X-ray and electron diffraction of clays and clay minerals

DR FRANS VERDOORN, Managing Editor, *Chronica Botanica* has been elected a Corresponding Member of the International Academy for the History of Science in Paris and Chairman of the newly established International Phytohistorical Committee of the International Union of Biological Sciences The Committee will have its headquarters at the Los Angeles State and County Arboretum, Arcadia, California It will sponsor a census of current research in the history of the Pure and Applied Biological Sciences

Dr Verdoorn has accepted the Directorship of the new Los Angeles State and County Arboretum at Arcadia, California

A symposium on 'The opportunities for chemical and allied industries in West Bengal' with a view to explore the possibilities of the development of alkali industry, carbonization and gas industry, nitrogen industry and pharmaceutical and fine chemical industry, will be held at the University College of Science, Calcutta on December 25, 1948 under the auspices of the 'Applied Chemistry Students' Reunion' Dr B C Guha, Member, Damodar Valley Corporation will preside

Dr Jen Hsu, Assistant Professor of Botany, National Peking University, Peiping, China, is appointed Curator, Institute of Paleobotany, Lucknow He obtained his doctorate from the Lucknow University and worked under Prof B Sahni, F R S Earlier he worked on plant anatomy in U S A

THE Thirty-Sixth Sessions of the Indian Science Congress Association will meet at Allahabad from January 3 to January 8, 1949 The meeting will be held under the auspices of the Allahabad University under the presidentship of Dr Sir K S Krishnan, Director, National Physical Laboratory, Delhi Her Excellency Sreejukta Sarojini Naidu, Governor of United Provinces will inaugurate the sessions More than 1800 delegates are expected to attend this sessions from India, Burma, Ceylon and Afghanistan Eminent scientists and delegates from Great Britain, France, U S A, Canada, Hungary and Russia will include among others Sir Robert Robinson, Sir Henry Tizzard, Prof S Chapman and Prof K Zeuner (U K), Prof Madame Curie-Joliot (France), Prof Hermann Merck and Dr George Strode (U S A), Prof C H Best (Canada), Prof Szent-Gyorgyi (Hungary), and Prof Engelhardt (U S S R) After plenary sessions the Congress will divide into thirteen sections, each to be presided over by a distinguished Indian scientist (see SCIENCE AND CULTURE, *13*, February, 1948, p 338) During the Congress sessions more than twenty scientific societies in India will hold their annual general meeting, including the Silver Jubilee Meeting of the Indian Chemical Society

ERRATUM

In November 1948 issue, p 202, Column 1, line 15 *read* 'Soil' *for* 'Sentence'

BOOK REVIEWS

Food Famine and Nutritional diseases in Travancore (1943-44) Surveys -By K G Sivaswamy, K K Chandy and ten doctors Pp XII + 176 + 36 + 42—Servindia Kerala Relief Centre, Coimbatore, 1945 Price Rs 5/-

Food Control and Nutrition Surveys Malabar and South Kanara —By K G Sivaswamy and others published by Servindia Kerala Relief Centre, Madras, 1946 Price Rs 4/-

Famine, Rationing and Food policy in Cochin—By K G Sivaswamy and Medical surveys by T S Shastry and J A Bhat Published by Servindia Kerala Relief Centre, Madras, 1946 Price Rs 3/-

Inadequate Diets, deaths, diseases and a food plan for Madras—By K G Sivaswamy Nutritional diseases by M P Chack

Food Hints —By S Gurubatham Published by Servants of India Society, Madras Price Rs 2/-

This group of publications by social welfare workers of the Servants of India Society is a valuable contribution to the study of living conditions in the Kerala country in Madras Presidency The authors carried out in a splendid series of team work, elaborate nutritional and disease surveys in Shertellay, North Parur and certain other areas in Travancore, as well as in several villages in the Cochin State and also in Malabar and South Kanara Official records and semi-official registers were also carefully examined for price indexes, procurement figures, vital statistics and other data and the story told by these figures with regard to famine and malnutrition are set out in detail

The food policy followed, its failure, and official inadequacy in the face of terrible human suffering are depicted vividly and with accuracy As the team of surveyors included a large number of qualified medical men, the data collected regarding diseases of malnutrition, and the suggestions regarding possible ways of improving the diet are specially valuable

K P C

Field Songs of Chhatisgarh—By S C Dube Pp XVIII + 95 Edited by D N Majumdar The Universal Publishers Ltd, Lucknow, 1947 Price Rs 3/12/-

This extremely well got up publication is the second book of the Folk Culture Series brought out by Dr Majumdar There is a paper of moderate length describing the cultural pattern of the United Provinces from the pen of the editor Then follows the main piece, which furnishes the title to the book The songs are valuable aids to the study of psychology and social custom of the tribes concerned At the end come seven short folk tales of Kolhan collected by Dr Majumdar

The Editor is rendering useful service to folklore by his publication

K P C

Photoelasticity Vol. II—Max M Frocht John Wiley & Sons Inc, New York, 1948, Cloth, 6" × 9¼", Pp 505, 438 figs Price $10 00

To the many advances that have been made in the field of applied science the growth and development of photoelasticity marks a new chapter in engineering and heralds a new era in the domain of stress analysis Among the pioneers of this science, Dr Frocht occupies a very prominent place and this second volume maintains the same high standard as Vol I, which was published in 1941 The present volume forms a continuation of the discussion of the subject into its more advanced aspects and will prove of great use to the research worker

The book consists of fourteen chapters (together with an appendix), containing three main topics of discussion The first part is a detailed introduction to the 2-dimensional theory of elasticity Results of optical and elastic theory are given to show their close collaboration, and the two methods of analysis, presented in the form of comparative stress patterns The question of the influence of the material on the stress distribution of multiply-connected bodies, omitted in the first volume receives adequate importance The determination of the sums of principal stresses at isolated points forms the second part This leads to a detailed survey of the various methods of solving Laplace's equation including the "linear rosette" method developed by the author himself These solutions have also important applications in heat transfer, electricity and hydrodynamics The third part dealing with 3 dimensional photoelasticity is undoubtedly the most important in the volume and covers practically all untrodden ground In this section are included among others, a new demonstration of the general stress optic law in three dimensions, theory and applitions of oblique incidence, and stress concentration studies in relation to fatigue tests In the appendix a description is given of 'Fosterite' a new material for 3 dimensional photoelasticity which is especially useful for frozen stress patterns. It is named after its

inventor N C Foster, Research Chemical Engineer, Westinghouse Research Laboratories, U S A

Since the opening of the photoelastic laboratory at the Carnegie Institute of Technology in the spring of 1932 the author as Assoc Prof of Mechanics has worked relentlessly to develop the technique of this science, which is best exemplified in the beautiful and clear "fringe" photographs which form the major bulk of illustrations of this as well as the previous volume As a minor criticism, it may be pointed out that the limitations of 3 dimensional photoelasticity and problems on stress concentration are not fully discussed, whereas the applications in structural engineering are completely omitted The symbols used in the application of oblique incidence to plane stress are rather confusing These few points however do not in any way reduce the worth of the book In fact since the publication of that classic work, "Treatise on Photoelasticity" by Coker & Filon (Cambridge) in 1930, this volume along with the first one constitutes the most advanced and up-to-date publication of its kind in the English language and enhances in a very high degree the reputation of the author who is now Research Professor of Mechanics and Director of Experimental Stress Analysis at the Illinois Institute of Technology, U S A Both in conception and in production this is an outstanding work by a recognised authority and deserves to be read by all interested in experimental stress analysis

S K G

The Damodar Valley Project—By S C Bose Published in September, 1948 by the Phoenix Press Limited, Calcutta Pp 139, with 41 illustrations and 2 tables Price Rs 4/-

This book is a remarkable factual study of the Damodar Valley from the pen of a geographer who has done extensive field work in the area, and has collected valuable new data, which he has presented in a simple non-technical manner

The book starts with a comprehensive account of the topography of the valley, and specially deals with the hydrology of the Damodar Delta It has laid bare the sorry record of man's interference in its natural development and the disastrous consequences of it Here it gives in three chapters the creation of the "Kana" or blind rivers, the beheading of previous distributaries, and consequent desiccation and the development of destructive "Hanas" or spill channels in the restricted delta inside the elbow of the river

The book then proceeds to describe the climate, natural vegetation and mineral wealth of the valley It gives in full detail the menace of soil erosion, describing various types of erosive forms, their extent and the degree of destruction caused by them Various causes which have lead to this unhappy state of affairs and the remedies are then discussed A chapter is devoted to a study of the population problems of the valley Rural and urban patterns of population, and the development of towns and their future as influenced by the project is then discussed

The flood problem of the river is exhaustively dealt with in the next chapter Various causes which have lead to the chronic flooding of the lower valley are given here, and methods of flood control, their advantages and disadvantages are discussed fully

In the end the book gives a critical study of the project dealing with the building of embankments and reservoirs, hydro-electric power development and irrigation

The book is profusely illustrated with maps, sketches and photographs drawn and taken by the author Two tables are provided giving the latest available details of the project

In short the book is an exposition in detail of the project and its background Besides satisfying the needs of persons in this country and abroad, who have an inquisitive mind and want to know facts about the project and the valley where it will come into being, the book is an intensive geographical study of the basin, and will prove very useful for teachers and students of higher geography It may be strongly recommended to those who wish to have a better understanding of the area and the reasons underlying the formulation of the project

K B

Electron and Nuclear Counters (theory and use)—By S A Korff, M A, Ph D, Published in February, 1948, by D Van Nostrand Co Inc, New York, Macmillan & Co Ltd, London Pp xi+212 Price $3 25

This book contains an up-to-date account of the mechanism of counter action The first chapter deals with the description of the discharge phenomena as a function of voltage, *i e*, in the low voltage region, proportional region, Geiger region, etc Important terms and symbols are explained at the end of this chapter The second, third and fourth chapters deal with ionisation chambers, proportional counters, Neutron counters and Geiger counters of various types Various constructional details of counters are discussed in chapter five and reliable methods for preparation of counters are recommended here The errors and corrections encountered in actual experiments are incorporated in chapter six The last chapter gives a discussion on the various electronic circuits that are in use in the operation of counters There is also a collection of useful references at the end

At the present time, counters are extensively used in various branches of research and industry

But the problem of making good counters is by no means an easy job. A great deal of work by a large number of investigators has already been done on this subject. Professor Korff is the leading experimental investigator in the field of neutron in cosmic rays and has considerable experience in making counters of various types. All his experiences and also those of other investigators in this field are excellently incorporated in this book.

Beginners in this field would have been more benefited if the author would have given the various circuit constants in all the circuit diagrams and recommended easy methods for "refilling" old counters that are found to change their characteristics after long use.

However, the book will be very useful to all workers in Nuclear Physics and Cosmic rays and to those workers in Medicine, Geo-Physics and Industry who use counters as a tool for their investigations.

P. C. B.

LETTERS TO THE EDITOR

[The Editors are not responsible for the views expressed in the letters.]

ON THE NUTRITION OF THE YOUNG STAGE OF FRESHWATER FISHES OF MADRAS*

REARING of fishes in ponds and other inland waters to meet the public demand for increased fish-production cannot be successfully accomplished without a knowledge of the food and feeding habits of the fish under culture. But the role played by any species of fish in the economy of aquatic life varies with its age. Little is known about the nutrition of the young stage of freshwater fishes of India. Of the work so far done the investigations of Mookerjee and his associates[4-11], Bhattacharya[2] and Alikunhi[1] are of special interest.

* Communicated with the kind permission of the Director of Industries and Commerce, Madras.

The food composition, in percentage of volume, of the fingerlings (below 3 inches) of the following 14 species of freshwater fishes of Madras is tabluated below: (1) *Barbus tor* (Ham.), (2) *B. carnaticus*, Jerdon, (3) *B. hexagonolepis*, McClell., (4) *Cirrhina reba* (Ham.), (5) *C. cirrhosa* (Bl.), (6) *C. fulungee* (Sykes), (7) *Labeo fimbriatus* (Bloch), (8) *L. calbasu* (Ham.), (9) *Silundia sykesii* (Day), (10) *Callichrous bimaculatus* (Bloch), (11) *Macrones cavasius* (Ham.), (12) *M. seenghala* (Byks), (13) *Bagarius bagarius* (Ham.), and (14) *Wallagonia attu* (Bl.).

	Barbus tor	*B. carnaticus*	*B. hexagonolepis*	*Cirrhina reba*	*C. cirrhosa*	*C. fulungee*	*Labeo fimbriatus*	*L. calbasu*	*Silundia sykesii*	*Callichrous bimaculatus*	*Macrones cavasius*	*M. seenghala*	*Bagarius bagarius*	*Wallagonia attu*
Number of guts examined	120	150	300	380	100	100	350	100	30	50	100	100	50	100
Gut contents														
Desmidiaceae	10%	3%				10%	30%	5%						5%
Closterium	X	X	—	—	—	X	X	X	—	—	—	—	—	X
Cosmarium	—	—	—	—	—	X	X	X	—	—	—	—	—	X
Desmidium	X	—	—	—	—	—	X	—	—	—	—	—	—	—
Eurastrum	X	X	—	—	—	X	X	—	—	—	—	—	—	—
Staurastrum	X	—	—	—	—	X	X	—	—	—	—	—	—	—
Diatomaceae	25%	10%	30%	20%	58%	25%	40%	30%			3%	8%		5%
Amphora	—	—	—	X	—	—	—	X	—	—	—	—	—	—
Anomoeoneis	—	—	—	—	—	—	—	X	—	—	—	—	—	—
Cocconeis	—	X	—	—	—	—	X	—	—	—	—	—	—	—
Cyclotella	X	X	—	—	X	—	X	—	—	—	—	—	—	—
Cymbella	—	—	—	—	—	—	X	—	—	—	—	—	—	—
Eunotia	—	—	X	—	X	—	X	X	—	—	X	—	—	X
Fragilaria	X	+	—	—	—	X	X	X	—	—	X	—	—	X
Gomphonema	—	—	—	—	—	X	X	—	—	—	—	—	—	—
Gyrosigma	X	—	X	—	—	X	—	—	—	—	—	—	—	—
Melosira	X	—	X	—	X	—	X	X	—	—	X	X	—	—
Navicula	X	—	—	X	—	—	X	X	—	—	—	X	—	—

	Barbus tor	*B carnaticus*	*B hexagonolepis*	*Cirrhina reba*	*C cirrhosa*	*C fulungee*	*Labeo fimbriatus*	*L calbasu*	*Silundia sykesii*	*Callichrous bimaculatus*	*Macrones cavasius*	*M seenghala*	*Bagarius bagarius*	*Wallagonia attu*
Nitzschia	—	—	—	—	X	X	—	X	—	—	X	—	—	X
Pinnularia	X	—	X	X	—	—	X	—	—	—	—	X	—	—
Surirella	—	X	X	—	—	—	X	—	—	—	—	—	—	—
Stephanodiscus	X	—	X	—	X	—	—	X	—	—	—	—	—	—
Synedra	X	—	—	—	X	X	X	X	—	—	X	—	—	—
Stauroneis	—	—	—	—	—	—	X	—	—	—	—	—	—	—
Tabellaria	—	—	X	X	—	X	X	—	—	—	—	—	—	—
Algae (other than Desmids and Diatoms)	30%	30%	30%	50%	20%	65%		25%				50%		10%
Anabaena	—	X	X	—	X	X	—	—	—	—	—	X	—	—
Ankistrodesmus	—	X	—	—	X	—	—	—	—	—	—	—	—	—
Aphanocapsa	—	X	—	—	—	X	—	—	—	—	—	—	—	—
Chaetophora	—	—	—	—	—	—	—	X	—	—	—	—	—	—
Lyngbya	—	—	—	X	—	—	—	X	—	—	—	—	—	—
Oedogonium	—	—	—	—	—	—	—	—	—	—	—	—	—	X
Oscillatoria	X	X	X	X	—	X	—	X	—	—	—	X	—	X
Pandorina	X	—	—	—	X	—	—	—	—	—	—	—	—	—
Pediastrum	X	—	X	—	X	—	—	—	—	—	—	—	—	—
Rhizoclonium	—	—	—	X	—	—	—	—	—	—	—	—	—	—
Spirogyra	X	X	X	X	—	X	—	X	—	—	—	X	—	X
Spirulina	X	X	—	—	—	—	—	—	—	—	—	X	—	X
Ulothrix	X	—	X	—	—	—	—	—	—	—	—	—	—	—
Protozoa		5%	5%				10%	5%						
Euglena	—	—	—	—	—	—	X	—	—	—	—	—	—	—
Eudorina	—	X	X	—	—	—	X	X	—	—	—	—	—	—
Phacus	—	X	—	—	—	—	X	X	—	—	—	—	—	—
Stentor	—	X	X	—	—	—	—	—	—	—	—	—	—	—
Vorticella	—	—	X	—	—	—	X	—	—	—	—	—	—	—
Rotifera	4%		8%	4%			3%	5%						
Hydatina	X	—	X	X	—	—	X	X	—	—	—	—	—	—
Mollusca										2%				
Gastropod shells	—	—	—	—	—	—	—	—	—	X	—	—	—	—
Crustacea	15%	5%	25%	10%	20%		15%		15%	10%	10%		15%	10%
Copepods	X	X	X	X	X	—	X	—	—	—	—	—	—	X
Daphnids	X	—	X	X	X	—	X	—	—	—	—	—	—	—
Cypridopsis	—	—	X	—	X	—	X	—	—	—	—	—	—	—
Nauplius	—	—	X	—	X	—	—	—	—	—	—	—	—	—
Caridina	—	—	—	—	—	—	—	—	X	X	X	—	X	X
Palaemon	—	—	—	—	—	—	—	—	X	X	—	—	X	—
Paratelphusa	—	—	—	—	—	—	—	—	—	—	X	—	—	—
Insecta	15%	45%		8%				12%	80%	80%	80%	30%	30%	30%
Diptera larva	—	X	—	—	—	—	—	—	—	—	—	—	—	—
Ephemeroptera larva	X	X	—	—	—	—	—	X	—	—	X	—	—	—
Odonota larva	—	X	—	—	—	—	—	X	—	X	X	—	X	—
Coleoptera larva	—	X	—	X	—	—	—	—	X	X	X	X	X	X
Corixa	X	—	—	—	—	—	—	—	X	X	X	X	X	X
Notonecta	X	—	—	—	—	—	—	—	X	X	X	X	X	X
Gerris	—	—	—	—	—	—	—	—	X	X	—	—	—	—
Ranatra	—	—	—	—	—	—	—	—	X	—	—	—	—	X
Hydrometra	—	X	—	—	—	—	—	—	X	X	—	—	X	—
Pisces									5%	8%	5%	10%	55%	40%
Panchax panchax	—	—	—	—	—	—	—	—	—	—	—	—	X	—
Aplocheilus blochii	—	—	—	—	—	—	—	—	X	—	—	—	X	X
Oryzias melastigma	—	—	—	—	—	—	—	—	—	—	—	—	—	X
Amblypharyngodon mola	—	—	—	—	—	—	—	—	X	X	—	—	—	—
Barbus stigma	—	—	—	—	—	—	—	—	—	X	X	—	X	X
Nuria danrica	—	—	—	—	—	—	—	—	—	—	X	X	—	—
Danio aequipinnatus	—	—	—	—	—	—	—	—	X	—	—	X	X	—
Gambusia affinis	—	—	—	—	—	—	—	—	—	—	—	—	—	X
Mud, sand, etc	1%	2%	2%	4%	2%		2%	3%			2%	2%		

(Note. x indicates presence of the organism in the gut).

The food of the young stages of the majority of the species consists of diatoms and crustaceans The production of these organisms involves only the simple technique of adding fertilisers to the fish ponds Piscivorous tendency is noted in the siluroids , they therefore should be segregated from the farms Eight species include insect life in their diet in their early stages, and may therefore prove useful in the reduction of mosquito larvae as suggested by Chatterji[3] and Roy[12]

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VARIATION OF GEOSTROPHIC WINDS AT UPPER LEVELS

ASSUMING the truth of the statical equation,

$$\frac{\partial p}{\partial z} = -g\rho \, , \quad \ldots \tag{1}$$

Brunt[1] gives the following quations

$$\frac{u}{T} = \frac{u_o}{T_o} - \frac{g}{2w \sin\phi}\int_{z_o}^{z} \frac{1}{T^2}\frac{\partial T}{\partial y}\,dz \tag{2}$$

$$\frac{v}{T} = \frac{v_o}{T_o} + \frac{g}{2w \sin\phi}\int_{z_o}^{z} \frac{1}{T^2}\frac{\partial T}{\partial x}\,dz,$$

where u_o, v_o are the components of geostrophic wind at height z_o, the absolute temperature is T_o and the other symbols having the usual meanings

Thus the geostrophic wind is regarded as made up of two components: (*a*) a component equal to the geostrophic wind at level z_0 reduced in the ratio T/T_o and (*b*) a thermal wind whose components are

$$\frac{-gT}{2w \sin\phi}\int_{z_o}^{z} \frac{1}{T^2}\frac{\partial T}{\partial y}\,dz \text{ and } \frac{+gT}{2w \sin\phi}\int_{z_o}^{z} \frac{1}{T^2}\frac{\partial T}{\partial x}\,dz$$

showing that the thermal wind blows around low temperatures in the same sense that the geostrophic wind blows around low pressures and that it keeps low temperatures to its left Utilising the above equations, both Brunt and Normand[2] have shown that a wind veering with height brings warmer air while one backing with height brings colder air

In discussing the problem of forecasting upper winds in the atmosphere, Petterssen[3] has deduced three different expressions for the variation in the geostrophic wind through a layer of air They are

$$U_1 = U_0\frac{\rho_o}{\rho_1} + g\frac{z_1 - z_o}{\lambda\rho_1}\frac{\partial p_m}{\partial y}, \quad V_1 = V_0\frac{\rho_o}{\rho_1} - g \times \frac{z_1 - z_0}{\lambda\rho_1}\frac{\partial p_m}{\partial x} \tag{3}$$

$$U_1 = U_0\frac{T_1}{T_0} + g\frac{z_1 - z_0}{\lambda} T_1 \frac{\partial}{\partial y}\left(\frac{1}{T_H}\right), \quad V_1 = V_0\frac{T_1}{T_0} - g \times \frac{z_1 - z_0}{\lambda} T_1 \frac{\partial}{\partial x}\left(\frac{1}{T_H}\right) \tag{4}$$

and

$$U_1 = U_0 + \frac{R}{g\lambda}\log\left(\frac{p_1}{p_2}\right)\frac{\partial T_M}{\partial y}, \quad V_1 = V_0 - \frac{R}{g\lambda} \times \log\left(\frac{p_1}{p_0}\right)\frac{\partial T_M}{\partial x} \tag{5}$$

where U and V are the components of geostrophic wind and $\lambda = 2w \sin\phi$, the suffixes 1 and o refer to higher and lower levels, p is pressure, g acceleration of gravity, ρ density, ρ_m is horizontal mean density, *i e*, the mean density within the horizontal layer, and z height, T_H harmonic mean temperature of the horizontal layer, T_M the mean temperature of the isobaric layer

Now there is yet another alternate way of expressing the variation in the geostrophic wind through a layer of air From the hydrostatic equation

$$dp = -g\rho\,dz$$

we have $$p_1 - p_0 = -g\int_{z_0}^{z_1}\rho\,dz \;\ldots \tag{6}$$

where the integration is from level z_0 to z_1.

If $\bar{\rho}$ is the mean density of the layer, then

$$p_1 - p_0 = -g\,(z_1 - z_0)\,\bar{\rho} \quad \ldots\ldots \tag{7}$$

Consider a layer of air bounded by the two pressure surfaces p_1 and p_0 Then only z_1 and z_0 vary with x and y and from equation (7) we get

$$\left.\begin{aligned} \rho_M\, g \left(\frac{\partial z_1}{\partial x} - \frac{\partial z_0}{\partial x}\right) &= -g\,(z_1 - z_0)\,\frac{\partial \rho_M}{\partial x} \\ \rho_M\, g \left(\frac{\partial z_1}{\partial y} - \frac{\partial z_0}{\partial y}\right) &= -g\,(z_1 - z_0)\,\frac{\partial \rho_M}{\partial y} \end{aligned}\right\} \qquad (8)$$

Here ρ_m denotes the mean density within the isobaric sheet

This is called as "Isobaric Mean Density"

Using geostrophic wind relations, we have

$$\left.\begin{aligned} \frac{1}{\rho_1}\frac{\partial p_1}{\partial x} &= \lambda V_1, & \frac{1}{\rho_1}\frac{\partial p_1}{\partial y} &= -\lambda U_1 \\ \frac{1}{\rho_0}\frac{\partial p_0}{\partial x} &= \lambda V_0, & \frac{1}{\rho_0}\frac{\partial p_0}{\partial y} &= -\lambda U_0 \end{aligned}\right\} \qquad (9)$$

Eliminate ρ, using equation (5)

$$\text{Then,}\quad \left.\begin{aligned} \lambda V_1 &= g\frac{\partial z_1}{\partial x}, & \lambda U_1 &= -g\frac{\partial z_1}{\partial y} \\ \lambda V_0 &= g\frac{\partial z_0}{\partial x}, & \lambda U_0 &= -g\frac{\partial z_0}{\partial y} \end{aligned}\right\} \qquad (10)$$

Substitute from equations (10) into equation (8)

$$\text{Then,}\quad \left.\begin{aligned} U_1 &= U_0 + \frac{g}{\lambda}(z_1 - z_0)\ \frac{1}{\rho_M}\frac{\partial \rho_M}{\partial y} \\ V_1 &= V_0 - \frac{g}{\lambda}(z_1 - z_0)\ \frac{1}{\rho_M}\frac{\rho_M}{\partial x} \end{aligned}\right\} \qquad (11)$$

Thus, a new expression, involving the "Isobaric Mean Density" is derived for the variation in the geostrophic wind, through a layer of air

The wind difference (U_1-U_0 , V_1-V_0) is proportional to the gradient of the logarithm of Isobaric Mean Density and to the variable (z_1—z_0) and that the geostrophic wind blows along isobaric mean density lines with higher density to the left of the wind

It is interesting to note that whereas the geostrophic wind has to be multiplied by the density ratio ρ_0/ρ_1 when horizontal mean density is considered, there is no multiplying factor involved when isobaric mean density is used Further, if the first terms on the right hand side of equations (3), (4), (5) and (11) are used, as first approximations, it is found that both (5) and (11) give identical results The approximations arise only if infinitesimal or very close layers are considered In such a case, the results from all the equations will be nearly the same

It can also be seen that equations (5) and (11) are identical and are simple transformations of one from the other

This supports the view that when we are making deductions of the distribution of temperature, we are making rough deductions about the distribution of density also.

The Isobaric Mean Density can be worked out if p_1, p_0 and distribution of T are known from the equations

$$\left.\begin{aligned} \frac{\partial \log \rho_M}{\partial x} &= \frac{R}{g\,(z_1 - z_0)}\log\frac{p_1}{p_0}\,\frac{\partial T_M}{\partial x} \\ \frac{\partial \log \rho_M}{\partial y} &= \frac{R}{g\,(z_1 - z_0)}\log\frac{p_1}{p_0}\,\frac{\partial T_M}{\partial y} \end{aligned}\right\} \qquad (12)$$

Further work is in progress

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25-3-48

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INVESTIGATION ON SOYABEAN-MILK POWDER

As a result of extensive studies on the food value of soyabean by different workers in India under Soyabean Sub-committee of the Nutrition Advisory Committee of the Indian Research Fund Association[1], it has been reported that soyabean is not superior to other Indian pulses as a supplement to typical Indian diets based on cereals As the percentage of crude protein of soyabean is higher than those of other pulses, attention was, therefore, directed towards the application of this seed as milk in the feeding of infants and young children It has been reported previously from this laboratory[2] that soyabean milk is inferior to cow milk when used as supplement to rice diet Besides this, the soyabean milk presents some unpleasant odour and taste for which the practical application as milk in India seems to be difficult It was, therefore, thought necessary to see whether this soyabean milk can be made in the form of powder avoiding the undesirable residue responsible for bad odour The soyabean milk powder was prepared in this laboratory in the following way

Soyabean previously soaked in water for 24 hours was heated with water after addition of a few c cs of glycerin for about one hour It was then thoroughly washed to get rid of the seed coat and ground into a fine paste in a stone mortar with minimum amount of water This was mixed thoroughly with four times its volume of water boiled and filtered through a muslin The filtrate was then evaporated to dryness under reduced pressure The fine powder obtained from the evaporated residue possessed pleasant odour and taste The average composition of the soyabean milk powder thus obtained was as follows

Protein	41 70 p c
Fat	33 45 p c
Carbohydrate	18 42 p c
Ash	4 37 p c

The biological value and the digestibility of the soyabean milk powder protein as deduced by the balance sheet method on rats were found to be 69 7 and 89 2 respectively

Previous investigation from this laboratory[1] on the biological value of protein of the whole soyabean has shown its value in the region of 45 to 50 The high value obtained in the present investigation suggests that soaking for 24 hours which effects partial germination in the seed brings about some changes in the amino acid make-up of the protein moiety of *Lathyrus sativa* after provoking some photochemical reactions Investigation on the amino acid composition of the protein of soyabean before and after germination will throw new light in the subject

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SEWAGE-SICKNESS OF SOIL

'Sewage-sickness' of soil and soil sickness in general have long been subjects of considerable interest, and valuable information has been collected by a number of workers[1-5] Further information is needed, however, regarding the major cause or causes of the sickness of soil Our recent observations may be summarised as follows

In the same area where healthy and sick patches occur side by side, the latter are usually sticky and retain higher percentages of moisture than the former The mechanical structure and chemical composition of the sick soils are also altered showing (*a*) higher percentages of fine silt and clay, (*b*) decreased pore space, (*c*) greater amounts of extractable phosphorus, and (*d*) accumulation of sodium The aqueous extracts from the sick patches contain greater amounts of salts and also permanganate reducing matter than those from the healthy area Nitrification in the sick patches is most negligible, and the micro-organisms are characteristic of sewage stagnating in puddles and undergoing anaerobic decomposition The following results would illustrate the above (Table I)

Experiments with the sewage-sick soil have shown that they can be reclaimed, as in the case of other sick soils, by heating them, by changing the surface layers of the soil, or by treating them with chemicals, such as burnt lime at the rate of 1 to 2 tons per acre followed by rest for 3 to 4 weeks The immediate increase in the crop yield (French beans, *Phaseolus vulgaris*) as effected by these treatments of the soil was 20 to 25 per cent When sewage irrigation was replaced by that with clean water the difference was much more striking, the increase in the crop yield being 100 to 300 per cent over the untreated control The response of French beans (in pots) to the different treatments of the sick soil is shown in fig 1

TABLE I

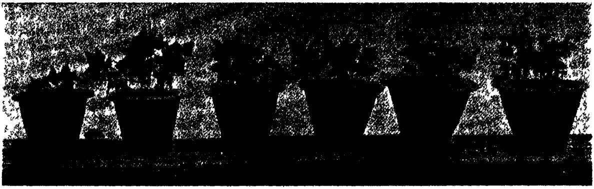
Results of analyses of sewage sick and healthy soils from the Bangalore sewage farm

	Sick soil	Healthy soil
Moisture (percentage)	15 5	8 6
Fine silt (,,)	6 5	4 6
Clay (,,)	22 1	14 9
Pore space (,,)	28 0	40·0
Permanganate reducing matter in terms of oxygen absorbed in 3 minutes (parts per 10,000)	74	32
do in 4 hours (parts per 100,000)	374	148
Carbonate carbon (parts per 100,000)	170	31
Organic carbon (parts per 100,000)	865	338
Total nitrogen (N) (parts per 100,000)	58	24
Total phosphoric acid (P_2O_5) (parts per 100,000)	222	92
1% citric soluble phosphoric acid (P_2O_5) (parts per 100,000)	16	9
Chloride (Cl) in 1 5 water extract (parts per 100,000)	80	14

The effects of varying amounts of different constituents of sewage (the organic matter, fats, sodium chloride, etc) on the soil conditions and plant growth have been studied[6] The accumulating evidence would suggest that the soil in the sick patches gets deflocculated and the air space is considerably reduced by the gradual deposition of materials carried with the sewage and through formation of alkali salts Under these conditions, the percolation is seriously affected , the organic matter of sewage is not easily oxidised, and the air supply to plant roots is reduced

Different crops, such as *ragi*, paddy and tomato, were successfully grown on vigorously aerated sewage in the Activated Sludge Tank The yields obtained were, on an average, two to three times those obtained under the best soil conditions Similar plants when grown on sewage with reduced or intermittent aeration showed poor growth such as seen on moderately sick soils. When the aeration was stopped for more

than a few hours, the plants wilted and died exactly in the same way as observed on planting seedlings on soil which is in an advanced condition of sickness These observations show that plants can tolerate even high concentrations of sewage provided the air supply is adequate If the latter is reduced, the effects associated with sickness are noticeable This has been repeatedly confirmed by pot experiments with different types of clay and sandy soils (soils containing varying amounts of clay) It would therefore appear that apart from the other known factors, air supply plays an important part in determining the extent of sickness on soil



(a) (b) (c) (d) (e) (f)

FIG 1 Growth of French beans (*Phaseolus vulgaris*) in sewage sick soil treated in different ways

a Sewage-sick soil only, without any treatment (control)
b Swage-sick soil treated with burnt lime (10 gms per pot)
c Sewage-sick soil heated (heated *en masse*)
d Sewage-sick soil surface heated
e Sewage-sick soil at the top and garden soil at the bottom (1 1)
f Sewage sick soil at the bottom and garden soil at the top (1 1)

The observations on the sewage farm at Madura (South India)[6] which has been working for the last twenty-one years are also important in this connection The farm is properly underdrained and the sewage matter accumulating on the surface of the soil is periodically scraped out So long as the latter operation is carried out at regular intervals and the underdrains work efficiently, the crop yields (mostly guinea grass) are maintained at a high level (*e g*, 120 tons of grass per acre per annum) If, as it has happened on a few occasions, the material deposited on the soil surface is not removed in time, the oxidation of sewage is adversely affected and the crop yields diminish Maintenance of aerobic conditions is thus essential for the prevention of soil sickness and failure of crops

A critical study of the extensive mass of data collected both by us and the workers in other parts of the World would show that, although there may be a number of individual factors leading to diminished crop yields and other features associated with sewage-sickness, the most important factor which pre-determines such effects is the extent of air supply to the plant The evidence collected by us would show that, if liberal air supply to plant roots could be ensured through one of the various treatments, all the other influencing factors are practically eliminated, and healthy and even luxuriant development of plants could be obtained It would therefore follow that in the reclamation of sewage-sick soils, the foremost consideration should be given to conditions favouring improved root aeration

Further studies on the various related aspects are in progress

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ON THE ROLE OF OXYGEN IN THE FUNCTION OF PROTEOLYTIC ENZYMES

EXTENSIVE investigations are on record on the mode of enzymatic activity of proteolytic enzymes In connection with a work on the deterioration of pepsin in solution[1] it has been noticed that lowering of the solubility and inactivation of the function of oxygen helps in the stabilisation of the enzyme in solution It has recently been recorded by Stadie *et al*[2] that oxygen at high pressure has no significant effect on the peptic activity On the other hand observations of Milas[3] tend to indicate that the rate of enzymatic activity would not vary so long as the surface of the substrate remains saturated with oxygen The question naturally arises as to whether oxygen is at the root of the activity of proteolytic enzymes Working in this direction it is being found that the peptic hydrolysis of proteins is dependent on the presence of oxygen

Thus a casein solution made free of dissolved oxygen by boiling and covered by a thick layer of liquid paraffin did not undergo any hydrolysis in the presence of a trace of an ester of gallic acid (added as an antioxidant to the substrate) in 3 hours at 40°C when acted on by 4% pepsin (1 10,000), and the extent of hydrolysis that took place in the same covered solution without the antioxidant was only 2% of the hydrolysis that occurred in the presence of oxygen only Pancreatin (U S P), however, was found under the same condition to behave contrary to pepsin In the case of papain again observations tend to show that most probably it contains either a system of enzyme having more than one active centre or two enzymes, where one is favoured by the presence of oxygen and the other is partially inactive Incorporation of antioxidant has again been found to partially inhibit or to augment the hydrolysis as the case may be, but certain other secondary reactions such as the formation of coloured complex with the heavy metals in the case of trypsin or papain (of Ray[4]) play a significant role in the enzymatic hydrolysis Thus the hydrolysis of protein by pancreatin in the absence of oxygen was found to be somewhat inhibited by the addition of an antioxidant, while such an antioxidant under similar anaerobic condition augmented the rate of hydrolysis in the case of papain Details of the investigation are being published elsewhere.

N RAY

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Calcutta, 17-9-1948

[1] Basu & Roy, *Ind Pharmacist* (in press), 1948
[2] Stadie *et al*, *J Biol*, *161*, 175, 1945
[3] Milas, *Chem Rev*, *10*, 275, 1932
[4] Ray, N, *J Ind Chem Soc*, *23*, 313, 1946

ANION EXCHANGE IN COLLOIDAL SOLUTIONS OF FERRIC AND ALUMINIUM OXIDES

THE role of iron and aluminium oxides either in the sol or gel states in the fixation of phosphate by the soil is not clearly understood[1] It has been variously suggested that phosphates are fixed by these oxides by anion exchange This aspect of the process has been systematically studied, using other anions besides phosphate and the present note briefly summarises some of the results obtained

The sols were prepared by precipitating the respective hydroxides from their chloride solutions by ammonium hydroxide, washing the precipitate, peptising the same with a small quantity of hydrochloric acid, finally dialysing and ageing for almost a month

The anion exchange was studied in the following ways (1) A measured quantity of the electrolyte solution containing the particular anion was added to a known quantity of the colloidal solution and after four or five days, as required to reach equilibrium, the added anion was estimated in the clear supernatant liquid obtained either by centrifuging or by filtration The amount of anion adsorbed under the particular equilibrium condition was calculated from the difference in the concentration of added anion before and after the reaction, (2) A measured quantity of the colloidal solution was kept with the electrolyte solution (not necessarily measured) containing the anion concerned for 24 hours and the coagulum was leached with a sufficient volume of the solution on a filter paper The coagulum was washed with aqueous alcohol to make it free from intermicellary electrolytes and then leached with a solution containing a suitable anion The exchanged anion in the leachate was estimated

In the ferric oxide sol the anions tried by both the methods were bromate, sulphate, thiosulphate, dichromate, molybdate and phosphate With oxalate, citrate and salicylate ions the predominant reaction with the ferric oxide system was probably the formation of complex compounds, as the sol visibly altered in appearance The other anions, except the phosphate were taken up by an exchange process and they could be replaced by suitable anions In the case of phosphate, however, a certain fraction of the total amount adsorbed could not be replaced even by continuous leaching This "fixed" fraction was estimated in the residue left after all the replaceable phosphate was removed With decrease in *p*H of the leaching solution, the fraction of the exchangeable as well as the fixed phosphate increased, the former very rapidly and the latter only slightly Similar exchange property was observed with the ferric oxide gel prepared by evaporating the sol on the water bath

In the case of aluminium oxide sol the anions used were oxalate, sulphate, dichromate, salicylate,

thiosulphate and molybdate They were all taken up in exchangeable forms As regards the interaction with the phosphate aluminium oxide sol behaves similarly to the ferric oxide system The effect of pH on the exchangeable as well as the fixed forms of phosphate was almost the same as in the ferric oxide sol

The sols studied appear to possess what may be called an anion exchange capacity The values obtained by method (2) above correspond to this anion exchange capacity analogous to the cation exchange capacity of siliceous clays and similar systems Ferric oxide sol possesses 2 to 3 times the anion exchange capacity of the aluminium oxide sol Investigations are in progress to ascertain the best conditions for determining the anion exchange

My thanks are due to Dr S K Mukherjee, of the Department of Applied Chemistry for suggesting the problem and giving me laboratory facilities, and to Sri A Choudhury for collaborating with me in the work on phosphate fixation

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Calcutta, 21-9-1948

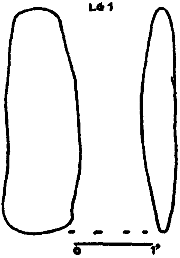
[1] Midgley, *Proc Soil Sci Soc, Amer*, 5, 24, 1940

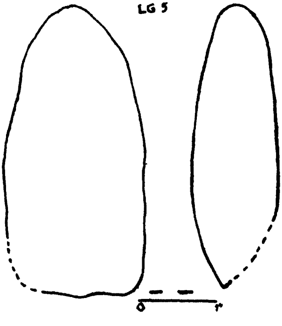
A NOTE ON SOME CELTS AND CHISELS FROM WEST BENGAL

THE site where the above artefacts have been found is situated on what appears to be a mound near the village Bamal about three miles south of Lalgarh in the Jhargram Sub-division of the Midnapur district in West Bengal There is a deep meander of the Kasai river about a mile west of the place and there are two ox-bow lakes about half a mile south-west indicating a past channel of the river

Outcrop of solid geology is lacking The country rock is laterite underlain at places by lithomarge and overlain by lateritic soil A section near Pratappur on the river reveals a bed of pebbly laterite (about 7′) underlain by a deposit of lithomarge of unknown depth overlain by a thick deposit (about 40′) of reddish yellow sandy clay with ferruginous concretions towards the bottom At the top there is a soil cap of about 5′ in thickness

At or near the site, however, there is no lateritic exposure nor any other rock No deposit of gravel is found here The site is about 50′ high above the present level of the river The contour height round this place is 200′ above S L according to the Survey of India map The soil is blackish at the top which seems to be fairly rich in humus But the soil below is reddish yellow not unlike the reddish yellow sandy clap observed near Pratappur about two miles north of this place Gulley erosion is fairly strong here and the mantle of soil is being rapidly eroded by gulley formation



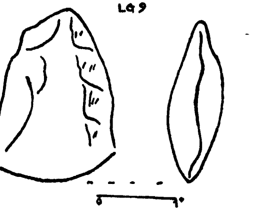


A collection of twelve stone implements which include ground celts and chisels of Neolithic type was made from the surface, that is from the top, and from the gullies Presumably the celts lying in the gullies have come out by weathering Two specimens, one a chisel and the other a celt, were obtained *in situ*

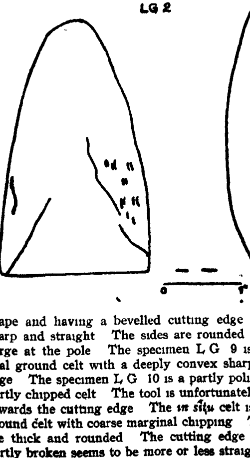
by cutting a small trial trench The chisel was found at a depth of 1″ while the celt was found at 2′ 10″ from the ground surface

The celts, excepting one, are all ground celts with slight traces of chipping at the sides Three of these are worth mentioning here The specimen No L G 2 is smoothly ground celt, triangular in

LG 9



LG 2



shape and having a bevelled cutting edge which is sharp and straight The sides are rounded and converge at the pole The specimen L G 9 is a small oval ground celt with a deeply convex sharp cutting edge The specimen L G 10 is a partly polished and partly chipped celt The tool is unfortunately broken towards the cutting edge The *in situ* celt is a crude ground celt with coarse marginal chipping The sides are thick and rounded The cutting edge which is partly broken seems to be more or less straight The long slender chisel (L G 1) found *in situ*, is a smoothly ground tool with a sharp cutting edge, slightly rounded at the sides There are traces of fracture at the pole

The implements are probably made of some basic igneous rock, of grayish green colour Some specimens show a whitish patination

This is the first discovery of stone implements of Neolithic type found *in situ* in Bengal In 1937-38 a number of small celts or chisels, microliths, beads as well as some iron implements were collected from the surface of a flood plain at Nadiha on the Damodar near Durgapur [1] Previous to this, Ball[2] discovered a tool of palaeolithic type in Bengal (Bankura) in 1875

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[1] Report Arch Surv of India, 1937-38
[2] Ball, V, *Proc As Soc Bengal*, 1876

NOTES ON THE AFFINITIES OF *MORINGACEAE*

The genus *Moringa* with about a dozen species of xerophytic trees has been considered sufficiently distinct to be included in a family, *Moringaceae* The relationship of this family with other groups of plants has been a subject of some speculation In view of some similarity in the characters of the stamens, de Candolle (Prod 2, 478, 1825) included *Moringa* under *Leguminosae* within the tribe *Cassieae* Grisebach and Baillon considered *Moringaceae* as belonging to *Rhoeadales* There are a number of other views which have been summarised in a recent paper by Datta and Mitra [1] These two authors have also proposed that *Moringaceae* should be taken out of *Rhoeadales* (*sensu* Engler and Prantl), or *Capparidales* (*sensu* Hutchinson), and be placed with *Violaceae* under the order *Violales* The family *Violaceae* like some other families, such as, *Polygalaceae, Bignoniaceae, Melianthaceae* etc have been mentioned as affording some characters for comparison with *Moringaceae* (Engl Pflanzenfam *17B*, 696, 1936), but in view of several other characters, none was bold enough to suggest that *Moringaceae* should be taken out of the orders *Rhoeadales* or *Capparidales* This has now been proposed by Datta and Mitra While fully admitting that such discussion on problems of phylogeny may not lead us anywhere outside the field of speculation, it may be still profitable to point out certain objections to this proposed change

It appears that these authors have overlooked Jumelle's interesting paper[2] on the species of *Moringa*

in Madagascar, where, after some very interesting discussion on the affinities of the family *Moringaceae*, Jumelle emphasised the close association of this family with *Capparidaceae* He admitted that *Moringaceae*, with pentamerous flowers and tricarpellary ovary is rather distinct from the tetramerous flowers and bicarpellary ovary of *Capparidaceae*, but he could not reconcile in their segregation Apparently, Jumelle overlooked the characters of the remarkable family *Bretschneideraceae* from Yunnan, China, which should have been considered by him in this connection In *Bretschneidera sinensis* Hemsley (see fig in Engl Pflanzenfam *17B*, 700, 1936), we find a combination of characters between *Moringaceae* and *Capparidaceae*, and *Bretschneideraceae* should be regarded as something like a link between these two families This would further strengthen Jumelle's view Datta and Mitra have suggested that Hutchinson[3] by placing *Moringaceae* not far from *Violaceae* appeared to have agreed partly to their line of thoughts The present writer had the privilege of discussing this point with Dr Hutchinson at the Kew Herbarium, and he is now in a position to elucidate Hutchinson's opinion In his original arrangement, Hutchinson included *Moringaceae* within the order *Capparidales*, in the *continuous* ascending series *Rhoeadales, Loasales, Capparidales, Cruciales, Violales*, and *Polygalales* As such, transference of one family, from one order to another, on more adequate evidence, (as suggested by Datta and Mitra) appears to be justifiable But, on further consideration, Hutchinson himself has slightly changed his earlier view He considers that a complete break in the series after *Capparidales* is now justified According to him, the order *Capparidales* has a predominantly arborescent origin and should be regarded as an end point of a particular line of development That is, there is a definite break between *Capparidales* and the following orders, e g , *Cruciales, Violales* and *Polygalales*—which are to be regarded as of herbaceous origin This modified opinion of Hutchinson (now in MSS) further supports the association of *Moringaceae* with *Capparidaceae* more strongly than it was before Due to this proposed break in the continuity of the series, it would appear now difficult to transfer *Moringaceae* from the order *Capparidales*, to *Violales* In broad characters, the family *Moringaceae* contains large xerophytic trees, with bi- or tripinnate leaves, gum sacs, homochlamydeous perianth, short calyx tube, gynophore, five staminodes, and long loculicidal capsular fruit All these are very different from *Violaceae* Admittedly, there are some other characters of similarity, such as, pentamerous zygomorphic flowers, nature of embryo-sac, structure of pollen grains etc Some of these cytological characters may be quite helpful in deciding the relationship of the genera *within* a natural family, but with larger groups, these may have only supplementary values In his interesting paper,[4] Maheshwari has shown that the *Fritillaria*-type of embryo-sac has been recorded in a number of Dicotyledonous families These observations do not however suggest that the genus *Fritillaria* may be phylogenetically associated with some of these Dicotyledonous groups Similarly, the statement (Datta and Mitra *l c*) "with the maturity of the embryo the whole endosperm is used up and consequently the seed is non-endospermic in *Moringaceae*"—is too general to be of any particular interest in a phylogenetic discussion

In the opinion of the present writer, *Moringaceae* has stronger links with *Capparidaceae* than with *Violaceae* This has been emphasised by Jumelle, and *Moringaceae* should remain within the order *Capparidales* The characters of *Bretschneideraceae* afford some definite support to such a view besides, the presence of myrosine cells in both *Moringaceae* and *Capparidaceae* The writer is also taking advantage of this note, to cite the synonyms and the correct name of the commonly cultivated *Moringa* of India, Burma, and Ceylon

Moringa oleifera Lam *Encl* *1* 398 (1785)
Guilandina moringa Linn *Sp Pl* 381 (1753)
Hyperanthera moringa Vahl *Symb Bot* *1* 30 (1790)
Anoma moringa Lour *Fl Cochinch* 279 (1790)
Anoma morunga Lour *Fl Cochinch* 279 (1790),
Moringa pterygosperma Gaertn *Fruct* 2, 314 et tab 147 (1791),
Moringa erecta Salisb *Prod Stirp Allert* 326 (1796)
Moringa zeylanica Pers *Syn* *1* 461 (1805)
Moringa polygona DC *Prod* *2* 278 (1825)
Moringa domestica Buch-Ham *Mem Wern Soc* *5*, pt 2, 371 (1826)
Moringa moringa (Linn) Millsp *Pub Field Columb Mus Bot* Ser *1* 490 (1902)
Moringa moringa (Linn) Small, *Fl S E United States* 491 (1903)

Some authors have suggested that *Moringa octogona* Stokes (*Bot Mat Med* , 2, 466, 1812) is a synonym of *Moringa oleifera* Lam But the former appears to be a doubtful species, as it is stated to have ten perfect stamens

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[1] *Journ Bomb Nat Hist Soc* *47*, 355, 1947
[2] *Ann Musee Col Marseille*, Ser *4*, fasc 1, 1930
[3] *Fam Fl Pl* *1*, 12-13, 1926
[4] *Ind Bot Soc M O P Iyengar Com* Vol 10t, 1946

// SCIENCE AND CULTURE

A Monthly Journal of Natural and Cultural Sciences

Vol. 14 JANUARY 1949 No 7

UNIVERSITY GRANTS COMMITTEE

ON account of the long association of this country with the United Kingdom, its public Institutions have almost invariably been set up on the same pattern as the corresponding bodies in Great Britain Thus we have our parliament, ministries, universities, self-governing bodies like municipal corporations, scientific departments bearing almost the same names as their prototypes in the U K One of the latest addition to these bodies has been the University Grants Committee created in 1946 It was clearly so named in imitation of the University Grants Committee set up in the United Kingdom in 1919 to review the works and schemes of expansions of University education from a national point of view, and give them substantial financial aid to enable them to come up to the standard suited to national requirements

The proposal of creating a U G C in India was first mooted in the Sargent Committee Report on Post-War Development of Education in India, and two leading members of the British U G C were brought down to tour this country explaining to the university authorities the role of the Committee in the U K * When, however, the U G C was actually set up, its scope was restricted to only the three universities which the Department of Education of the Government of India considered to be its charge proper,—namely, the University of Delhi at the head-quarters of the Government, and the Universities of Aligarh and Benares which had come under the Central Administration for extra-academic reasons It is said that the fiction of "Central Universities" was invented by the Education Department, which found itself overworked, without sufficient finance or staff, and after a heroic effort to convince the Viceroy's Cabinet that university education through out India should be their charge, fell back upon the fiction of "Central Universities" so that they might not be worked to exhaustion ,—it had no backing by a Cabinet Resolution A U G C thus set up under a Government with such limited reference to look after the needs of only three individual universities, which had no provincial connotations, could hardly be expected to think in terms of national needs, national outlook and national education, and it was futile to expect that this U G C would render the same service to Indian University Education as the corresponding British body has rendered to British University Education The first Indian U G C of 1945 was composed of a Chairman and 3 members, and though in 1946 the Committee was enlarged to one consisting of a Chairman and 6 members, the terms of reference remained unchanged,—as if, a mere increase of the personnel could get over the limitations referred to above In fact, in spite of the grand manner in which it was heralded and its grandiloquent name, the U G C during these two years was frankly and avowedly a mere appendage of the Department of Education of the Government of India with a very limited function, and looking only after the needs of the Universities of Delhi, Aligarh, and Benares

It was in 1947 after the attainment of Independence that the first Indian U G C worth the name and with its scope extended to all the Universities in the Indian Union, was constituted by the first Education Minister under the National Government, Maulana Abul Kalam Azad, with a chairman and 8 members *

* We had occasion to discuss the University Grants Committee as envisaged by the Sargent Report in one of the series of articles we published on "Scientific Education and Research in Relation to National Welfare" (See SCIENCE AND CULTURE, 10, 409, 1945).

* The Rt Hon'ble Dr M R Javakar, *Chairman* (Jurist), Sir S S Bhatnagar (Chemist then Secretary to Govt of India, Ministry of Education), Dr Zakir Husain (Vice-

The terms of reference are

"To make enquiries and recommendations regarding

(i) the lines on which the Universities should develop ,

(ii) the additional amounts in the forms of grants-in-aid from public funds required for these ,

and (iii) the co-ordination of their activities with a view to avoiding unnecessary overlapping "

Free India has now a National Government, and it is but natural that the New Indian U G C has been invested with power to look after the financial needs of, and to formulate plans for, University Education that would be adequate to national needs According to the terms of reference, the National Government had clearly done away with the fiction of "Central Universities", and recognised clearly that as the future administrators, public servants, scientific and technical men—in fact all the personnel needed to run and develop a modern State had to be recruited impartially from all parts of India, all University Education and higher research should be their charge, and it would be hazardous for the unity and development of India, if University Education was left entirely to the fissiparous policies of provincial legislatures and caprices of the local party politics It is, however, necessary to ensure at the outset that the Indian U G C may not be satisfied with the mere identity in name and similarity in the terms of reference with those of the U G C in Great Britain, but that it may be as conscious of the nature and scope of its responsibilities, and as earnest and thorough in discharging the same as the British U G C It is to this end that we publish elsewhere in this issue an article on the function and working of the British U G C and the expansion of University Education in that country brought about through its efforts during the last 30 years We propose now to review some of the lessons brought out in that study with a view to their adoption by our U G C

The composition of the Committee is more important than is usually thought of The composition of the British U G C * recognises the principle that a purely academic body like the U G C should consist entirely of teachers and academicians, and of experts in some of the subjects taught in the Universities There is no representation of the grant-giving body as such in the Committee (Parliament in this case), and no official of the Ministry of Education or of the Treasury Our U G C is composed of very brilliant men, *but nevertheless the selection lacks almost all the above features of the British U G C* *

There is prevalent in our country a practice of providing representation for the Legislatures or Local Bodies or private donors, on academic bodies to whom they may sanction grants or donations, irrespective of their competence to speak on matters educational It is but natural for donors to be assured that their grants are properly utilized and they may rightly insist on strictest audit and on administration by an independent body of academicians and experts , but it would not be desirable to make the grants or donations a ground for forcing non-academic representation on academic bodies It is our experience that such men have not in the past, been able to give time and attention It is all the more true for the composition of the U G C which is the academic body created to act as Trustees of the grant-giving bodies or persons

During the first year of its existence, the reconstituted Indian U G C received applications for grants from the Universities, supported by necessary statements, scrutinised these applications in a 3 days' sitting, and recommended grants for these Universities to the Ministry of Education There was no attempt to contact the Universities,—far less to contact the various other limbs that constitute a University, which has been the most noticeable feature of the working of the British U G C In fact, it appears from the composition of the Committee that such visits, and any form of sustained and continuous working throughout the year which alone can enable the U G C to arrive at a correct estimate of national needs of higher education, are not even contemplated The Committee has a *Secretary* who is on the staff of the Ministry of Education The Committee should be an autonomous and independent unit with its own full-time *Chairman* and a *Secretary* and a small staff, if it is to do its work properly, and it ought to study the needs of University Education by means of periodic tours and personal contacts with the universities in a friendly spirit

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Chancellor Aligarh University) Mrs Hansa Mehta (Ex Minister, Bombay representing Medicine), Sir Homy Mody (Industrialist), the Hon'ble Dr B C Roy (Premier, West Bengal representing Medicine), Prof Meghnad Saha (Physicist) Dr P Subbarayan (Politician), Mr K Zachariah (Historian Public Service Commissioner)—*Members* Dr P Narasimhayya, *Secretary* who is on the staff of the Education Ministry none else is a full timer

* Sir Walter Moberly, whole time *Chairman* (Philosopher) Dr A F Trueman, whole time *Deputy Chairman* (Geologist) Sir Charles Darwin (Physicist), Mr H L Elvin (representing expert knowledge in Librarianship), Sir Peter Innes (Retired Education Official), Mr H S Magnay (Education Officer), Prof W E Collinson (Language) Miss D dymond (Economic History), Miss Margery Fry (Ex-Principal Sociology), Prof P S Noble (Classics), Prof G W Pickering (Medicine), Prof E K Rideal (Chemistry), Prof A Robertson (Chemistry), Sir Edward Salisbury (Botany), Prof J C Spence (Medicine) and Prof R H Tawney (History)—*Members* The Committee has its own whole-time Secretary and secretarial staff

* We may notice in passing that the personnel of the Universities Commission have been on more desirable lines (see SCIENCE AND CULTURE, December, 1948, p 241)

The working of our U G C during the last year has revealed another fundamental defect in the set-up of our University Education The grants asked for by the universities were meant only to be utilized in the universities proper for post-graduate education only, and presumably the Committee also provided the grants for such limited purpose Our universities are used to consider only post-graduate students as University Students, and our U G C also appears to think in the same way The British U G C, on the other hand, caters for the needs not only of Research and Advanced students, but also for all First Degree and even post-Matriculation Diploma students The Treasury grant allocated by the British U G C to the University of London, for example, is appropriated not merely for the University College, but is equitably distributed between all other constituent Colleges and Schools of the London University

Whatever the drawbacks in its composition, and the shortcoming of its mode of working, and however circumscribed its outlook, the Indian U G C recommended substantial grants-in-aid to the different universities for the year 1948-49 But even this little work has been marred by the relation of this U G C to the Ministries of the Central Government The British U G C is a Committee of the Treasury It makes out a case for financial aid to universities and other institutions of university rank on the basis of study of their needs carried out throughout the year, makes an estimate of the total grant required for education at the University stage and places its recommendations before the Chancellor of the Exchequer, and successive chancellors have always accepted these recommendations in their entirety And once the grant is voted by the Parliament, the U G C proceeds to distribute the total grant among the different universities, there is no occasion for reference to the Education Ministry at any stage or to the Treasury The Indian U G C, on the other hand, being a Committee of the Education Ministry, whatever grants were recommended by the U G C for the universities had first to be approved by the Education Ministry, then every item with the recommendation of this Ministry was further examined so very critically and thoroughly by that Superministry, the Ministry of Finance, that it is no wonder that after passing through these two bottle-necks very few items finally emerged out of the archives of the Government intact, in fact none to our knowledge so far as the so-called non-Central Universities are concerned * A large number of doctors were called to cure the patient, and their elaborate treatment has completely killed the patient

The problem of University Education is indeed very difficult and intricate in India, because of the vastness of the country, with its much larger population, the existence of autonomous Governments in the Provinces simultaneously with a Government at the Centre, and its much more slender finances The needs of the country for education at the First Degree and higher stages must be carefully estimated, both on a short-term and a long term basis, and this need must be met by a judicious and economical distribution of available provisions It has further to be ensured that these provisions are made available to those of our young men who are most qualified to profit by them The cost of all these provisions must be allocated between the Centre and the Provinces on the one hand, and between Local Civic Bodies and the State on the other hand To undertake these enquiries the Government of India has appointed a Universities Commission But after this Survey is over, and the form of University Education most suited to the requirements of the nation and the genius of its people, has been formulated, and the measure of State aid necessary in relation to the number of University-trained personnel required for the country, has been estimated, it will be the duty and privilege of the Indian U G C—may be, aided by provincial Committees--to carry out the programme, and to ensure that India adopts a modern system of University education on a scale which will be comparable to those operating in leading countries of the West

To sum up Our recommendation is that the University Grants Committee can discharge its functions in a way consistent with the new educational responsibilities of free India, only if it is reorganised on the following lines

(1) University Education throughout India should be in the Concurrent List of the Draft Constitution of India

(2) The Central Government, as well as the States, should set apart a certain percentage of their revenue for education in general, and a certain part

* Amongst the so-called Central Universities, the University of Delhi, (and probably one or two others), thanks to the energy and persistency of its Vice Chancellor, Sir Maurice Gwyer, has been able to get ample grants out of the Central Government for the expansion of the University of Delhi The University at the Metropolis has now a campus of 600 acres, with large number of educational buildings, and with provision of residential quarters for teachers and dormitories for students The present state of the University of Delhi may be compared with that in 1935, when Sir Richard Gregory, Editor of *Nature* visited Allahabad and stayed with the writer of this article Sir Richard told him "I have been to a funny place at Delhi They showed me two rooms on the upper story of a shop, and said those were the Science Laboratories of the University of the Metropolis of India" Delhi has progressed, though not yet to the same standard in all subjects as the older universities, thanks to the efforts of Sir Maurice Gwyer, while Allahabad, Calcutta and other older Universities have remained stationary inspite of huge increase in the number of students and their requirements, the competence of their teachers, and past records and traditions This shows what leadership and personal initiative can do inspite of odds

of it should be reserved for University Education This should be incorporated in the Draft Constitution *

* The Chinese Government has a clause in its constitution that 15 per cent of its revenue should be spent on Education Contrasted with that the Central Government of India spends less than 1 per cent of its income on Education, though some of the Provincial Governments of India spend liberally on education, e g the Government of Bombay which spends 18 per cent, other Governments are very economical on education The West Bengal Government, entirely composed of members elected on Congress ticket, spends only 6½ per cent and we are told on high authority that of this, a substantial amount is going to be "Unspent Balance" The present West Bengal Government has thus outdone the League Government in killing education, for even the League Government spent 12 per cent The West Bengal Government has been extremely economical on the salaries of starving teachers belonging to primary, secondary, collegiate and university rank

(3) The U G C should be reorganised on the lines suggested in this article, with a whole-time *Chairman*, a *Secretary* and a secretariat staff The members may—in view of the history of the relations of the universities in this country with the Central and the Provincial Governments—be selected by the Ministry of Education, but the Committee should be an independent and autonomous one, and further, a convention should grow up so that its estimate of the total State aid necessary for University education will be forwarded in tact by the Ministry of Education, and accepted *in toto* by the Ministry of Finance so long as the amount sought is within the national resources, and after the amount is sanctioned by the Parliament, the allocation of the total grant to individual universities will be made only in accordance with the recommendations of the Committee

UNIVERSITY GRANTS COMMITTEE IN ENGLAND*

RAMANI MOHAN ROY,

INDIAN ASSOCIATION FOR THE CULTIVATION OF SCIENCE, CALCUTTA

A UNIVERSITY Grants Committee is now functioning in India and its scope now extends to all the Universities of the Indian Union It has been thought advisable to review the formation and growth, function and utility of the U G C in the U K so as to obtain data in the light of which it may be possible for the Indian U G C to adopt desirable lines of improvement It is also proposed to show how State aid on an increasingly generous scale has contributed towards the expansion of university education in Britain Such a study may be specially instructive at this stage, for unfortunately there is prevalent in this country a view that while it is the imperative duty of the State to make provisions for compulsory basic education, and to a less extent, for secondary education, university education in general —and post graduate education and research in particular—may be left to shift for themselves

FORMATION AND SCOPE OF THE U G C IN U K

In 1919-20, universities in the U K were in a position of great difficulty The number of full-time students in grant-in-aid universities and university colleges had risen from *roughly* 20,000 in 1900-01 and 28,000 in 1910-11, to well over 33,000 in 1919-20 The proportion of the number of university students was is yet only 1 in 1275 of the total population, it was 1 in 1000 in U S A and 1 in 710 in Germany Naturally there was an insistent demand for more university-trained personnel,—for more specialists in science, in commerce and in industry The World War I had further brought home to the administrators of the country the imperative necessity for research It was thus made clear that universities must all bring about all-round expansions to find places for a much larger number of students and researchers, ultimately for the service of the country

But the universities had their resources very much strained The salaries of the teachers were miserably low, and there was an acute shortage of teachers University buildings were inadequate and often unsuitable University libraries were starved—the annual expenditure on books ranging from £18 upwards ! There was no scope for increasing the tuition fees which were already much higher than in other countries State aid to *some* individual institutions sometimes came up to 34 per cent of the total revenues , but it was 80 per cent in German Universities, —the University of Berlin alone had State grants nearly equal to the total grants for universities and colleges in England and Wales The total parliamentary grant was £500,000 in U K , it was £2,000,000 in Germany and £7,000,000 in U S A Invested funds

* This article is based on Reports of University Grants Committee (Britain) for relevant years and an article by Margery Fry, *Universities Quarterly*, May, 1948

yielded a maximum of 15 per cent of the income in some of the British Universities, in U S A it formed 34 per cent Private benefactions amounted to £5,000,000 annually in U S A, in U K it totalled a bare one-twentieth of this amount All these combined to make it abundantly clear that the cost of provision for university education on a scale considered necessary for the country had far outstripped the total of endowments, private benefactions, grants from local authorities and income from students' fees, and that the time had come for the State to assure generously larger subventions for the universities

This, however, brought another question in its train Parliamentary grants must necessarily be subject to the vote of the parliament State aid had not so long been large enough in relation to the total finances of the universities, but it was likely that as this governmental aid began to gradually mount up, parliamentarians would become more vigilant in the exercise of their control Universities, on the other hand, were very jealous of their autonomy with regard to academic matters and control of expenditure of their funds, and it was certainly not desirable that universities should be subject to the vagaries of political conflict

That was the problem which confronted the Government, and the U G C was created in July, 1919, to strike a balance between these conflicting claims of educational autonomy, and parliamentary control of public finances Its first terms of reference were

> "To enquire into the financial needs of university education in the U K and to advise the Government as to the application of any grants made by Parliament towards meeting them"

In 1946 the U G C was invested with further duties in purely academic matters, and to the terms of reference was added

> "to collect, examine, and make available information on matters relating to university education at home and abroad, and to assist, in consultation with the universities and other bodies concerned, the preparation and execution of such plans for the development of the universities as may from time to time be required in order to ensure that they are fully adequate to national needs"

COMPOSITION

The Committee has now a full-time Chairman, a full-time Deputy Chairman, a Secretary and a small office staff It is thus an autonomous and independent unit Members all work in an honorary capacity, they are appointed for a term of five years, and consist of professors and heads of universities (and colleges), and experts drawn from outside these institutions who are considered capable of tendering advice on the needs of universities The personnel of the U G C for 1943, which is just now before the writer, shows that besides the Chairman, there were 14 other members including 2 members associated with the administration of the grant-earning bodies, 1 woman member who is an ex-Principal of a college, 1 Director of a Railway, 5 Professors or Principals and 5 experts who represented among themselves Economic History, Humanity, Language (German), Medicine, Mechanical Engineering, Botany, Physics, Chemistry, Education and Librarianship

The composition of the Committee is highly instructive, showing as it does that the selection of the personnel is made with an eye to the needs of representation of diverse subjects taught in the universities, irrespective of any form of regional representation, the selection shows further a balance between representation of teachers and non-teaching experts It is noticeable that there is no representative of the Ministry or of the Parliament as such, nor is there any person going in our country by the vague all embracing term of an 'educationist'

Working of the U G C—The U G C has grown into a position of authority and influence far greater than what its terms of reference seem to imply It has jurisdiction over 16 degree-giving universities in Great Britain *and their constituent institutions*, and Treasury grants to these fifty constituents are not made except on the recommendation of the Committee

The permanent officers of the Committee, and as many as possible of its members, visit all the constituent institutions during 12 months at the end of every five year period to see, at first hand, how far former grants have helped progress and what further aid, recurrent or capital, would be required by each for its desirable developments During such visits the Committee does not merely study the budget and financial statements of these institutions, but collects information regarding the status, salary and conditions of service of its teachers, development of the social life of its students, needs for scholarships and State assistance for stdents, and provisions made for finding employments for them, and also enquires into the standard of teaching and research, adequacy or otherwise of buildings, laboratories and their equipments, and library facilities It has been emphasised by the U G C in its reports and recognised by the constituent institutions, that it would be wrong to call such visits as "inspections" the Committee goes and is received there as a friend, may be a critical one,—it goes not merely to collect information, but also to get an overall picture of university economy, it is as ready to be helpful as to be critical During these visits the Committee makes it a point to interview not only the heads

of administrative and academic bodies, but it also contacts the junior staff, local leaders of public opinion, and the students In these conferences the Committee learns as much as it advises

On the basis of the knowledge thus gained the U G C presents *directly to the Treasury* (and not to the Board of Education or the Ministry of Education) an estimate of the needs of the universities Treasury grants are provided accordingly in the National Budget, and after these are voted by the Parliament the Treasury disburses the grant to individual institutions on the basis of distribution of the total grant as advised by the U G C Much of the present power and prestige of the U G C has been established as a result of conventions and practice followed by successive Chancellors of the Exchequer since the inception of the Committee Though under no obligations to do so, they have always followed the advice of the U G C in the matter of distribution of the voted sum between the several universities Even though the Parliament has the power of voting or withholding of universities' grant, by common consent this grant has ever been kept outside the caprices of parliamentary vote, and the parliament has never sought to interfere with the distribution of this grant between the different universities In this manner, the creation of the U G C has effectively cut out any direct political pressure upon any university As the U G C is a Committee of the Treasury (which corresponds to the Ministry of Finance in our country), and as its decisions are not subject to review by the Ministry, and there is no chance of the recommendations getting lost amidst the files of officials of the Government departments, there is no time lag between the recommendations and the universities getting aid

Some figures may now be considered to show what great strides have been made in university education in Great Britain, and to what immense degree governmental aid to universities has increased between the inception of the U G C in 1919 and the present times

TABLE I

SOURCES OF INCOME OF UNIVERSITIES

Year	Endowments		Donations & subscriptions	Grants from Local Authorities		Parliamentary Grants			Tuition Exam & other fees & Miscell	Total income
	Amount £	Percentage of Total income	Percentage of Total income	Amount £	Percentage of Total income	Treasury Grants[1] £	Total[2] £	Percentage of Total income	Percentage of Total income	£
1928-29	716,425	13 9	2 4	524,450	10 1	1,537,925	1,854,425	35 9	37 7	5 174,510
1934-35	845,905	13 9	2 7	598,393	9 9	1,800,830	2 058,914	33 9	39 6	6 072,651
1944-45	1,066,530	14 0	2 2	631,555	8 3	2,425,156	2,955,692	38 9	36 6	7,600,635
1945-46	1,151,757	11 2	1 9	704,711	6 9	4,491,326	5,069,525	49 3	30 7	10,280,470

[1] Parliamentary grants through U G C
[2] Total parliamentary grants, including 1

The *recurrent* Parliamentary grant which in 1919-20 was about £500,000 increased to nearly £5,000,000 in 1945-46, it is today of the order of £9,000,000 and is to rise to nearly £12,000,000 by 1951-52 The proportion of governmental aid to universities now amounts to more than half of their income, it will shortly increase to about two-thirds (Moreover the Government has undertaken to find many millions of pounds for capital expenditure during the next few years)

TABLE II

UNIVERSITY STUDENT POPULATION

Year	Full time students				Part-time students				Courses not of Univ standard	Attending extra-mural classes
	Research & Advance	First Degree	Diploma	Total	Research & Advance	First Degree	Diploma	Total		
1928-29	2,082	35 219	7 008	44,309	1,581	1,596	11,062	14,239	16,598	20,093
1934 35	2,866	39 284	8,488	50,638	1,969	1,808	9,635	13,412	13,570	28,045
1944-45	1,002	32,035	4,802	37,839	994	1,549	9,427	11,970	13,736	44,243
1945-46	2,691	42,568	6,363	51,622	1,946	1,904	11,702	15,552	13,209	53,766

In reckoning the Exchequer's contribution to university education, we must also consider the expenditure in scholarships and maintenance allowances borne by the State *in addition to direct grants to the universities* This amounts to £12,481,000 in 1947-48, and £14,562,000 in 1948 49 (the increase of about £2 million being provided for Further Education and Training grants to ex-service students at Technical and Arts Colleges)

Though the Parliament votes supply for the Universities' grant annually, it has come to be agreed that the recurrent grant settled will be available for a five years' period This enables the universities, and colleges to formulate development plans and budgets for a few years ahead

Thus assured of substantial State aid, the universities and colleges have been able to provide for an increasingly large number of student-places, as Table II (*q v*) will show

For comparison, it may be added that the number of full-time students was 20,249 (1 in every 1800 of total population of the country) in 1900 01, 27,728 (1 in 1450) in 1910-11, and 48,452 (1 in 880) in 1920-21 There has thus been a much larger proportionate increase in the number of university students than in the population of the country Even then the U K was lagging behind other advanced countries in the programme of university education, for, while in 1934-35 the university student-population was 1 in 880 of total population in U K, it was 1 in 808 in Italy, 1 in 604 in Germany and 1 in 480 in France The number of university students in U K has since further increased considerably, it was 51,622 in 1945-46, it is now about 76,500, and it is hoped that the target figure of 90,000 student-places in universities—which is the estimated need for the country—will be reached by 1955

It may be interesting to analyse the number of these full-time students to form an idea about the proportion of men and women students among them, and the number in different Faculties of the Universities (Tables III to V)

TABLE III

PROPORTION OF MEN AND WOMEN STUDENTS

(Full-time)

Year	Total No	Men No	Men %	Women No	Women %
1928 29	44,309	31,410	70 9	12,899	29 1
1934 35	50 638	38 406	75 8	12,232	24 2
1945 46	51,622	34 214	66 3	17,408	23 7

TABLE IV

FULL TIME STUDENTS IN DIFFERENT FACULTIES

	1923 24	1928 29	1934 35	1945 46
Arts	18,981	23,625	24,143	21,281
Pure Science	7,402	7,377	8,784	9,309
Medicine	10 997	8 387	12,500	13,210
Technology (including Engineering, Applied Chemistry, Mining, Metallurgy, etc)	4,709	4,082	4,369	6,284
Agriculture	856	838	842	1,538
TOTAL	42,945	44,309	50,638	51,622
(No entering the Universities for the first time)	—	13,000	14,487	—

It is noticeable that there is a gradual, though slow, swing towards Pure Science, Technology Medicine, and Agriculture after World War II Among Advanced Students, the *proportion* of students of Science has always been higher from the very beginning of the period under consideration (vide Table VI)

The U G C has so scrupulously respected the autonomy of the universities that it usually recommends for each university a block grant to the general income rather than grants for specific purposes or for particular departments, and the University is left free to make its allocations of the grant

TABLE V

DEGREES OBTAINED ACCORDING TO FACULTIES

Year	First Degree Hons	First Degree Pass	Higher Degrees	Total	Arts	Pure Science	Medicine	Technology	Agriculture
1928-29	4,798	3,867	1,138	9,803	5,646	2,244	878	888	147
1934-35	5 544	4,016	1,363	10,923	5,924	2,724	1,139	998	138

TABLE VI

No. of Full Time Advanced Students in different Faculties

	1928-29	1934-35
Arts	814	1,153
Pure Science	886	1,141
Medicine	100	192
Technology	238	325
Agriculture	44	55
Total	2,082	2,866

But from the discussions with the U.G.C. at the time of its quinquennial visit, the university has a clear idea as to what parts of its programme were approved by the Committee and considered in univ-

TABLE VII

	Grants from Local Authorities £	Treasury grants (Recurrent) £	Total Parliamentary grants £	Allocated to constituent Colleges & Schools £
Univ. of Durham	a	175,860	175,860	172,410
Univ. of London	142,140	1,512,250	1,654,390	1,603,415 b

a—Local Authority Grants were separately allotted to the University and the 2 constituent colleges

b—Excluding Endowments & Subscriptions granted *through* the Central Univ. authority

Grants allotted to *some* individual institutions were University College—£212,640; Imperial College of Science and Technology—£232,118; School of Economics—£101,426; Bedford College—£80,841; Birbeck College—£71,463; King's College—£144,685

TABLE VIII

Incomes of some Colleges and Schools of London University

	Endowments £	Donations £	Grants from Central Univ. Authority £	Other Parliamentary grants (Non recurrent) £	Grants for Teachers in Training £	Tuition etc. £	Other income £	Total £
University College	39,324	3,368	212,640	—	4,659	71,540	14,124	345,655
Imperial College of Science & Technology	9,732	11,050	232,118	29,077	—	51,624	9,352	342,953
School of Economics	15,549	2,324	101,426	—	377	42,345	7,344	169,365
Bedford College	4,274	2	80,840	—	8,118	20,787	1,193	115,215
Birbeck College	1,036	136	71,463	3,100	—	11,876	877	88,488
King's College	1,842	1	144,685	2,507	6,833	43,834	3,010	202,712
For comparison, the figures for a residential University (for the same year) may be added								
Cambridge Univ.	210,522	12,447	268,500*	90,684	3,528	232,279	163,711	981,671
And those for two new University Colleges which came under the aegis of the U.G.C. in 1945								
Hull Univ. College[1]	18,642	1,362	30,000*	1,379	1,669	4,105	4,356†	61,513
Leicester Univ. College[2]	7,679	282	12,000*	6,000	—	2,617	9,032‡	37,610

[1] Full time students 174
[2] ,, ,, =108

* Grants through U.G.C.

† Includes Local Authority grants of £3,350
‡ ,, ,, ,, ,, £8,910

TABLE IX

Expenditures of Universities

Year	Administration Amount £	Administration % of total	Departmental Maintenance: Teaching Staff £	Lab. etc. £	Library Museum & Observ. £	Total Amount £	Total % of total	Maintenance of premises % of total	Other Expenditure £	Capital expend. from income £	Total £
1928-29	453,735	8.9	2,594,844	581,486	164,731 29,173	3,370,234	65.8	11.1	563,697	166,657	5,122,937
1934-35	515,579	8.6	3,021,103	685,282	228,784 33,032	3,968,201	66.0	10.8	670,457	208,125	6,012,741
1945-46	868,816	9.0	4,539,298	1,337,849	319,111 31,662	6,227,920	64.4	12.1	984,912	419,943	9,980,066*

* Including £307,204 allocated to reserve

ing at the amount of the grant and for which further support might be expected in future If the university appropriates the grant for other projects, it knows that it cannot hope to get further support for the same

Table VII shows how a University of the type of the University of London, allocates the total State aid and Local Authority grants among its constituent Colleges and Schools (the figures are for 1945-46)

The incomes of the colleges mentioned in Note *b*, Table VII, were made up as shown in Table VIII

The heads and amounts of expenditure of the Universities have been tabulated in Table IX

It will be found that administration and maintenance of premises form 10 per cent each of the local expenses , the teaching and library staff, library and laboratory maintenance form roughly two-thirds of the expenses , while capital expenditure, students' amenities, examination, etc , are other items of expenditure

It would be desirable to tabulate the number of teachers in relation to student numbers (Table X)

TABLE X

	1928 29	1934 35
Professors	792	855
Readers and Asst Professors	332	374
Lecturers	1 123	1,391
Asst Lecturers	810	856
Others	202	259
TOTAL	3,259	3,735
Students	44,309* 14,239†	50,638* 13 412†

* Full-time † Part-time

In some of its earlier reports the U G C strongly expressed itself on the utter inadequacy of the salaries paid to the junior staff, but not much has been done yet to rectify the same The reports cover wide fields in matters academic, *e g* , discussion of the question of status of teachers of different grades, and ways of increasing their efficiency , and the diverse problems relating to the corporate life of students in universities, including students' amenities and health service , and the question of finding suitable employments to university-trained personnel, —to name only a few These are not relevant to the theme of this article, but they provide ample materials for consideration by administrators and academicians, and would no doubt be considered by the Universities Commission (see SCIENCE AND CULTURE, December, 1948, p 241) that has been set up in this country

Some of the points brought out by the above survey and Tables may be stated as follows

(*i*) The U G C was created in Britain to act as a buffer between the Parliament voting grants for university education and the recipient universities and university colleges The institutions have thus retained full academic independence even while receiving Governmental aid on an ever increasing scale

(*ii*) The Committee is composed only of academicians and experts,—there being no representation of the Parliament or of the Ministry as such, and no regional representation

(*iii*) The Committee works by making direct contacts with constituent bodies, and it has thus been able to act as a co-ordinating and levelling-up committee It has ensured that while every necessary subject is taught at some university, there may be an economical distribution of other 'rare' subjects

(*iv*) It reports direct to the Treasury and is thus independent of the Ministry of Education, which deals with primary, secondary and other forms of education, and Broadcast

(*v*) It must be realised that if a country is to maintain its position as a leading Nation of the world, it must ensure expansion of university education upto an estimated scale and the standard to be maintained should be not below the highest international levels For, it is from the university-trained personnel that the country must get its administrators, scientists, technicians, and leaders in every walk of life In the long run it would be disastrous to Industry if it fails to get first-rate men for the direction of their technical staff During war time the staff of the universities form the pool from which first grade men can be drawn for special research, for employment as officers or other purposes In short, study and research on a university level is essential for the well being of a modern State in peace, and for its safety in war Inevitably the State must come forward with an ever increasing share of the cost of university education

POWER AND COMBUSTION*

A G EGERTON, F R S †

SECRETARY, THE ROYAL SOCIETY LONDON

As an Englishman, I appreciate the honour that has been accorded to me and I can assure you that we shall do all that lies in our power to help and all the more because you in India now are independent and in the position to run your own shows and we are in the position of friends helping each other I believe that the scientists of the world can in working together in friendly ways be even more effective than they have yet been in establishing a state of forbearance and order in the world, for they can see and point out what the important material problems are and can influence those in authority to ensure that such things are done as will lead to prosperity and peace In the south of France one often sees two Cypress trees planted together and if one asks the peasants why? they will say "L'AUTRE POUR LA PROSPERITE, L'UN EST POUR LA PAIX"

I hope that the British science and Indian science can be two such trees

I want to say something about the work we have been doing in my laboratory on combustion, but before coming to that, may we first look at the world at large

Some years ago I tried to set down just what power was available to the world

Solar Energy and Power

The earth, as Harold Jeffreys quoted in his important monograph (The Earth, Cambridge University Press), is something humorous but lingering It was born of the sun some 2000 million years ago, but it settled down to a mean surface temperature of about 287°C not long (only in 20,000 years) after its birth, since then it has *lingered on* The sun is not more than about twice as old as the earth and it radiates energy corresponding to 5 10^{23} H P, and only 2×10^{-9} of the corresponding energy reaches the earth The source of the energy (according to Bethe) is the nuclear reaction The energy received on

$$\begin{array}{lcl}
C^{12} + H \longrightarrow N^{13} \longrightarrow \beta^{+} \longrightarrow & & C^{13} + H^{1} \\
\quad | & & \quad | \\
H + O^{15} & \longleftarrow & N^{14} + H \\
\quad | & & \\
(O^{16}) + \beta^{+} & & \\
\quad | & & \\
C^{12} + He^{4} & &
\end{array}$$

(C^{12} acts as catalyst for making four protons to combine into a helium atom The excess energy, equal to about 26 million electron volts per reaction sustains the sun as a source of energy)

the surface of the earth's outer atmosphere is 1 35 million ergs per sec per sq cm What happens to this energy? It goes in as radiation with intensity maximum at about 0 5μ, and it goes out as radiation reflected from the surface of the earth with maximum at about 10μ, the surface of the earth being maintained at 287°C on the average Of course, much of the radiation gets reflected back directly into space from clouds, part of it gets handed across within the atmosphere and in some parts of the earth very little of the 'effective' short wave radiation reaches the earth, but on some occasions and places $\frac{3}{4}$ of it may get through and be absorbed by the earth's surface, making possible provision of power equivalent to about 1 H P per sq meter of surface You in India get a big share of this life-giving energy

I am not a meteorologist but nevertheless I think the tracing out of this radiative equilibrium in the atmosphere is a fascinating problem Some years ago the GASSIOT Committee of the Royal Society, started to study the problem intensively I do not think there is yet agreement as to just what is happening It is known that the quantity of ozone in the upper atmosphere (which has a maximum in the region at about 50 km and is equivalent to a thickness of 3 mm of ozone at atmospheric pressure) is controlled by a complicated series of photochemical reactions which are essential to maintain the equilibrium Studies of this kind are of great scientific interest but also of great practical importance because meteorology is basic to the applied sciences —agriculture, as well as navigation, and of fundamental importance to prosperity The new technique of radar has greatly added to knowledge of the upper atmosphere Much information on the subject

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* A full text of a talk delivered under the auspices of the National Institute of Sciences of India on 10th Sept, 1948, in the University of Delhi

† Sir Alfred Egerton F R S is a famous physical chemist who has made fundamental contributions to the subject He has made study of the science of combustion as his life's objective As secretary of the Royal Society he has rendered important public services to his country in peace and war-time Recently he visited this country as Chairman of the Reviewing Committee appointed by the Government of India to review the workings of the Indian Institute of Science, Bangalore (See *Science and Culture* 14, 113, 1947)

is collected in a recent book by S. K. Mitra.* This radiant energy works a great engine of 2×10^{14} H.P., the sun is the furnace, the atmosphere the working substance and space the condenser—within this great engine potential energy is converted to kinetic and kinetic back to potential, work is done here and heat is dissipated there. The sun shines on the seas, the rain falls on the mountains, the waters fill the streams, they are trapped in a turbine, the lamps shine and heat is discharged again to the atmosphere and so on. The rivers and streams of the world were estimated by Arrhenius to possess about 4 times the energy of the coal consumed per year, (1400 million tons per year). Only about a tenth of the potential usable water power has yet been developed.

Let us list now the sources of power.

Effective' in flow of solar radiation	1.3×10^{14} H.P.
Power dissipated by lighting	1×10^{9}
Estimated potential hydroelectric power	3.2×10 ,,
Power corresponding to use of coal & oil	2×10^{9}
Power corresponding to radiant energy assimilated by plant life	3×10^{10} ,,

There are other sources of power.

(i) *Tidal*—1.5×10^{9} H.P. but very little of this can be used.

(ii) *Wind power*—but owing to its fickleness it is difficult to use but might be applied more than it is at present.

(iii) *Volcanic*—is of only local interest.

(iv) *Nuclear source*—popularly known as Atomic Energy, which lies in the future.

But really the important source of power is what we get through the process of photosynthesis, that gives us the peat and the wood we burn, it gave us once our coal and oil. We are now consuming that all in 1000 years while it took 30 million years to lay down. What do we know about photosynthesis—we may know a little—I am told that out of every 500 chlorophyll molecules only one is the active one in the assimilation process whereby the CO_2 is fixed and provides sugar etc. $6(CO_2 + H_2O) \longrightarrow C_6H_{12}O_6 + 6O_2$. The others though are all taking part, handing on radiant energy they have absorbed—but this fundamental process on which life depends, is not yet fully understood. I believe that under favourable conditions only 1/3000th of the solar energy falling on any considerable area of land is fixed by photosynthesis, the rest is absorbed as heat and is not utilised directly in growth, the light which falls on the green leaf may be absorbed with an average efficiency of about 1% but some plants may convert upto 6 or 7% of the energy. Some therefore have dreamt of improving this efficiency and that is worth a lot of endeavour. The human being eats on an average 10-20 times the energy in the form of food that he performs as mechanical work but one worker on the land ought to be able to produce (on the average in Great Britain) food enough for 10.* So it is that population tends to increase and is limited by area of land, water and productivity of soil. Three quarters of the world's activity is in the getting of food and fodder. Taken the world over, the total value of the cultivated products is 4 times that of all the other manufactured goods. Of the cultivated products 88% is food and fodder, 12% oils, fats, waxes, hemp, cotton, jute, silk, hides, rubber etc. and the food has to provide man and animals with energy for muscular effort, the sum total of which is equivalent to perhaps 50 million H.P. The mechanical power continuously employed in the world is probably equivalent to something of the same sort of order of power. Estimates have been made of H.P. per head but they are often misleading as they refer to installed power rather than power continuously in use. This power is got mainly from coal (about 1/5 from oil and natural gas). The mechanical power supplements muscular effort at the expense of stored fuel and if it did not mean that more mouths have to be fed, it would make work easier and increase leisure. It does produce a state of affairs such that a wider range of manufactured articles is available. 57% of the world's other activities apart from cultivation are for the getting of fuels for power and for heat. Products are derived by the aid of coal and upgraded into many different products—solvents, artificial textile materials, drugs, dyes etc., many of which are made more easily in this way than by (as it were) down-grading the products of cultivation. (Acetone for instance is made more easily by synthesis than from wood distillation). Of course the right thing to do is to try to increase productivity per hour and find means to make as much power as possible out of waste vegetable cultivation instead of using up our stored fuels. In India you rely on the ox to provide power for the village community purposes, but the H.P. he provides for an intake of quite high grade food is probably less

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* The Upper Atmosphere—Published by the Royal Asiatic Society of Bengal, 1948.

* This is the figure in England and U.S.A. In India, owing to primitiveness of methods, not less than 70% of the population is dependent on land, and of this nearly 80% (or 60% of the population) is busy in actual agriculture which includes food production, and raising of economic crops. This work is done in the U.S.A. by just 1/5 their proportion *i.e.*, 12% of the population. While we in India, with 70% of our population in agriculture do not produce sufficient food for feeding all the mouths in India, U.S.A. with only 12% produce plenty of food for their whole population, and for export of surplus.

This shows the importance of a 'Technological Revolution' without which the political revolution which resulted in Independence, may mean nothing and may lead to chaos and misery. *Science and Culture* is preaching this doctrine since 12 years.

than might be got with engines using waste vegetable products adapted to village life I cannot say how it would be best done, but the problem is there and I know you appreciate it I have experimented with methane as a fuel for internal combustion engines alternative to petroleum fuels, and it is possible to get methane by vegetable fermentation This might possibly form an approach to the problem but there are no doubt other possible ways of tackling the problem of how to give the cultivator a little extra power to help him in places where hydroelectric power is not easily available The possibilities in India are great, you have a tremendous supply of water, any amount of sunlight and little need of fuel for warmth We northerners, have to spend a ton and a half of coal per head per annum to supply warmth to keep us alive

In all this let us remember in tilling the land there is happiness eternal and a happy mean between machine and hand labour has to be found, with due consideration of the problem created by population increase I have read or glanced through Bhore Committee's report and know that you are alive to this problem

To talk of engines, sixty years ago Sir Charles Parsons was led to the invention of the reaction steam turbine by the need to increase the speed of torpedo boats, just as the speed of aircraft has led to the development of the gas turbine in these days Whittle, a test pilot, knew the need to increase the speed of aircraft and sought to apply the jet principle In any development of this kind there is first the urge for the solution of a broad practical problem in order to improve means, then the patient trial of ideas on quite a small scale and later, as results become promising, the scale is increased and eventually success is achieved

Combustion

My own interest in combustion came about more than 20 years ago through a short research carried out to find out for an oil company whether there was any other substance than lead tetraethyl which would act as an antiknock in Petrol engines Gates and I found that antiknocks did not effect gaseous detonation, but that in ignition of a gas mixture they had great effect and were acting as negative catalysts This led me to studies about combustion and the field of interest is quite inexaustible and many of the points which 20 years ago were outstanding are still not elucidated For instance when lead tetraethyl is inhibiting the combustion of a gas mixture, does it act, molecule by molecule or radical by radical with the radicals in the chain of oxidation of the hydrocarbon, or does it react because it is a particle of lead oxide of a certain minute size and gives a numerous small surfaces for the breaking of these chains of reaction? Here is a physical problem of high interest Dr Bimaldas Jain of the Delhi University and I have been working on this recently and it looks as if no single answer can be given to such a question because lead tetraethyl seems to prove particles of lead oxide whereas iron carbonyl seems to act as a vapour, radical by radical Semenoff, the Russian physical chemist, who first introduced Christiansen's chain reaction theory into combustion chemistry to explain the oxidation of phosphorus has accepted the views of the breaking of the chains by the antiknock but considers that it is particle size that matters, but this does not seem to explain the exceptional influence of the chemical character of the antiknock, for particles of similar size of zinc oxide to that of lead oxide have no effect We find that lead particles are nearly but not quite as effective as lead oxide particles, as oxygen is present, in all the mixtures it is probable that the metal oxide is necessary for the inhibition I have referred to this just to illustrate how an interesting practical problem leads one to fundamental studies The substances which are antiknocks have a specific effect in decomposing peroxides and it is the peroxides which play an essential role in my view in most combustion processes

We have found recently, following Poljakow, that even in the low pressure explosion of hydrogen and oxygen if the products are suddenly cooled (by liquid air) that 30% of hydrogen peroxide is present in the condensed ice This has been studied in detail and we found by absorption of monochromatic light in the region in which hydrogen peroxide absorbs, that the peroxide is formed not only at the surface from the combination of hydroxyl radicals, but also from the existence of exited HO_2 in the vapour state giving $HO_2 + H_2 \rightarrow H_2O_2 + H$ and it seems the H_2O_2 must exist for an appreciable time with energy in the rotational and vibrational degrees of freedom and then the energy is removed at the walls We have now extended this study to methane explosions In that case we get ozone, hydrogen peroxide and methyl hydrogen peroxide but no or very little formaldehyde, which has previously been considered as an essential product

In the combustion chambers of turbo-jet engines there is always the difficulty of some incompletion of combustion and loss of efficiency, some of the oil which is sprayed in may not get burnt or is cracked and the cracked carbonised particles take longer to burn, or again intermediate products are formed due to chilling and do not complete combustion Many of these difficulties have now been surmounted but at one time they were real difficulties They led me to suggest that a promoter such as is used for promoting

combustion in Diesel Engines and reducing the delay before ignition, might lower the limit of combustion or increase the velocity of flames and so improve the combustion in the chambers of jet engines Promoters such as ethyl nitrate were tried but had no effect So we set to work to find out why, experiments were done on the effect of promoters and inhibitors on velocity of flames and the limit compositions for propagation of flame We were led by the results to the view that, although these promoters effect ignition, they have little or no effect on combustion limits or velocity of flames (They had effects—quite large effects —but when their thermal contribution was taken into account, we found they were having little catalytic effect in modifying the oxidation reactions of the combustible with which they are mixed, as they do in ignition)

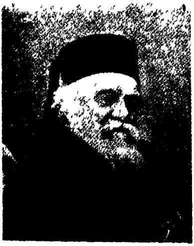
Imagine a stationary flame front with the unburnt gases flowing at the same velocity as the flame travels, the burnt gases flowing away so that the flame front remains still The gases ahead of the flame front are heated by the gas burning in the flame front and the old view was that the unburnt gas was heated to such temperature that the oxidation reactions auto-accelerate and burst into flame and so the flame front is maintained Actually the hot zone ahead of the flame is only about 1/30 mm thick and the time available for the auto-ignition is only about 1/10,000 of a second Now in ignition, delay times are considerable at atmospheric pressure and that alone makes the theory unlikely, add to that those substances which effect ignition reactions do not effect limits or velocity of flames, we find the theory still more unsatisfactory Following B Lewis, I think that flame is maintained by the radicals diffusing out into the unburnt gas ahead of the combustion zone—the flame actually lights the unburnt gas, it is quite a different phenomenon from ignition proper For instance, if petrol is injected into the cylinder of a Diesel Engine, there is no flame to start the ignition and there is a delay period before explosion occurs Addition of promoters then increases the rate of these preflame reactions That is an ignition phenomenon proper, and is different from flame propagation which is not influenced by the preflame reactions but only by the radicals in the flames We have been investigating this and have now succeeded in getting a flat stationary flame front independent of wall effects by which means we hope to measure the true velocity of flames, a problem which by the bunsen burner or the soap bubble, or the tube method is rather difficult Dr Gaydon in my laboratory has been studying flames at low pressure If you have a wide burner, a stable flame can be maintained at the burner down to as low pressure as 1 mm (for instance with acetylene) The flame thickness becomes very much greater and so one can find out at what stage in the combustion the various radicals appear, for instance OH may appear before CH or before $C=C$, each of these giving characteristic spectra From the spectra one can also determine the temperature of the radiators, the vibrational and rotational temperatures In certain flames he has found that the rotational temperature corresponds to very high values, 10000° Abs, for instance in the case of OH in hydrogen oxygen flames at low pressure In more recent work he has applied the Doppler's Principle and is measuring the translational temperature, so that although there is no temperature equilibrium in a flame up to the maximum temperature, we have been able to measure the individual motion of some of the reacting radicals We hope to learn more about flames and the freezing technique which I have mentioned earlier and this low pressure flame work are helping to provide this knowledge Incidentally I may mention Dr W N Vaidya's work in my laboratory on the hydro-carbon bands which he discovered Using deutero-acetylene he hopes to settle the constitution of the radical responsible for these bands What I have tried to stress in this talk is the seeking out of the general problems which are worth wrestling with, and their following it into its scientific ramifications, never minding too much the practical issues There is no hard line between applied and pure science and they foster each other They are foster brothers and we scientists in all lands are foster brothers under Mother Earth—*"Sacred Goddess, Mother Earth, thou from whose immortal bosom, gods and men and beasts have birth —leaf and blade, and bud and blossom"*

ARDASEER CURSETJEE* (1808-1877)— THE FIRST INDIAN FELLOW OF THE ROYAL SOCIETY

R A WADIA,
BOMBAY

WHEN the late Srinivasa Ramanujan, the well-known Mathematician and a genius in that branch of science, was elected a Fellow of the Royal Society, he was considered to be its First Indian Fellow This belief continued to be held till Prof A V Hill, the Secretary of the Society in his Address to the Press Representatives at Delhi in 1944 stated that the First Indian who had the honour to be the Society's Fellow was Mr Ardaseer Cursetjee and this has led me to write this short sketch of his life

From information gathered from the Secretary of the Royal Society it appears that Ardaseer was elected a Fellow on 27th March 1841 He was proposed by James Walker, seconded by W Cubitt and recommended by John Macneille, James Horne, Josua Field, W H Sykes, Sir John Barrow, Admiral F Beaufort and Sir Edward Sabine



ARDESEER CURSETJEE

The following Copy of Certificate received from the Secretary of the Royal Society is of interest —

"ARDASEER CURSETJEE ESQUIRE SHIP BUILDER OF BOMBAY lately in England having undertaken the journey of this country at his own expense in order to perfect himself in the knowledge of the Steam Engine as applicable to Navigation and to acquaint himself with the arts and the manufacturies of Europe with the view of improving his own country and his countrymen, a Gentleman well versed in the theory and practice of Naval Architecture and devoted to scientific pursuits having introduced Lighting by Gas into Bombay where he perfected a small Gas establishment aided exclusively by Native workmen, having also at his own charge built a vessel of sixty tons to which he adapted a Steam Engine sent out from this Country, and manufactured and fitted every other part of the Machinery and navigated the vessel entirely with native workmen and Engine men chiefly instructed and trained by himself, and having otherwise promoted Science and the useful art in his own country to which he has just returned, having while in England obtained the appointment of principal Inspector of Steam Machinery to the East India Company, being desirous of becoming a Fellow of the Royal Society—

We whose names are hereto subscribed of our personal knowledge consider him as deserving of that honour, as likely to become a valuable and useful member—And we beg to recommend him from his peculiar situation, and the proofs he has given of his desire to extend natural knowledge in India

Dated this twenty seventh day of March 1841"

Ardaseer belonged to the wellknown family of Lowjee Wadia who arrived in Bombay from Surat in the beginning of 1736 as a Ship-Builder and founded the Docks, and whose descendants continued to hold the post of Master Builder till 1885 when the post was abolished

He was born on 6th October 1808 His father Cursetjee Rustomjee (1788-1863) was Master Builder in the Dockyard from 1844 to 1858

As regards his education nothing definitely is known but it is apparent that he must have received the best available at the time before he entered the Dockyard as an apprentice in 1822, when he was only 14

We learn from his own writing that about the year 1830 he began to study the theory and practice of Steam Engine and to devote much of his time to the study of Marine Engineering With the permission of Government he was placed under Capt Mc Gillvary, the Chief Engineer of the Bombay Mint, where he worked for some time and acquired proficiency in that branch of Engineering To quote his own words "My enthusiastic love of Science now led me to construct unassisted, a small steam engine of about one horse power I likewise endeavoured to explain to my countrymen the nature and properties of steam and to effect this I had constructed at a great expense in England, a Marine Steam Engine which, being sent out to Bombay, I succeeded with the assistance of a native blacksmith in fixing in a boat of my own building"

* A brief sketch of the career of Ardaseer Cursetjee appeared in SCIENCE AND CULTURE, 9, 338, 1943-44 (Ed *Sci & Cul*)

This was the steamer "Indus" which was launched on 16th August, 1833, it being the first private steamer built on the Island, there being only one other steamer, the "Hugh Linsay" also built at Bombay for the East India Company by Nowrojee Jamsetjee, the Master Builder The "Indus" was subsequently purchased by the Bombay Government

Ardaseer brought up the same native black-smith to manage this steamer and drive and keep in order the engine without any assistance from Europeans and to quote his own words "This faithful native has worked the boat upwards of five years without a single accident or injury to the engine"

The great interest Ardaseer took in the engineering line led him to introduce Gas Lighting in Bombay On 10th March 1834 he lighted his bungalow and gardens at Mazagaon with gas when the Governor of Bombay, the Earl of Clare, visited the scene People from all parts of the town had gathered to see this novel experiment So great was the crowd that it was with some difficulty the Governor's carriage could pass According to the Bombay Gazette of the 15th March, there were twentyeight lights in the bungalow apart from a number of such lights in the compound Before departing, the Governor, it is recorded, presented a Dress of Honour to the host

Ardaseer was also the first to introduce Steam Pumps on the Island The Bombay Gazette of 15th April, 1834 wrote

"We have much pleasure in bringing to the notice of the public the ingenuity of a young Parsee gentleman of this place named Ardaseer Cursetjee This young man has for some time been engaged in studying works on steam machinery and gas and has in the progress of his experiment set up a small steam engine in his garden at Mazagaon which served to raise water from a well in his premises sufficient to supply a small fountain thereby demonstrating to his countrymen the great advantages which may be derived from the introduction of steam as a means of irrigating garden lands and improving the agricultural resources of the country"

It is to be remembered that at that time in constructing the necessary machinery and articles, there was no foundry or means of getting such works properly executed and yet the apparatus was found to be as complete as if the same was constructed in England This led him to maintain a small foundry at his premises at Mazagaon in order to make him proficient in the foundry business He made great many wrought iron tanks for ships, among which several were holding upwards of five thousand gallons of water

With the starting of the Elphinstone Institution in Bombay, professors in different branches of learning were brought out from England and one of them, Mr Arlebar, Professor of Mathematics, became acquainted with Ardaseer Witnessing his knowledge in practical mechanics, Mr Orlebar applied to the Bombay Government to allow Ardaseer to assist him in instructing the students specially in mechanical and chemical sciences to which Government readily consented

By this time steam navigation had considerably increased and difficulty in carrying out repairs to steamers was experienced It was noticed that few of the European engineers could withstand the Indian climate and a few others proved troublesome Ardaseer was quick enough to realise the advantage of further studies in this branch of science With the lofty object of giving benefit of his studies in England to his countrymen "in a branch of Science which has greater influence upon the interest of mankind, than all the discoveries of many past centuries", he determined to proceed to England to study Steam Power as an aid to the luxuries of civilized life

With this object in view he applied to the Governor, the Earl of Clare, to allow him to accompany His Excellency to England, but he was asked to wait for some time He thereafter went to China for a change

In 1838, with the sanction of the Bombay Government, Ardaseer made arrangement to proceed to England but sudden illness prevented him from proceeding there

Next year, however, Ardaseer was able to carry out his wish with the sanction of the Government of Bombay

On September 12, 1839, he left his home late in the evening for *S S* "Bernice" and went on board with Capt Cogan of the Indian Navy and the steamer left the shore early next morning He had decided to go by the overland route and Suez was reached on 7th October

The overland journey is described very graphically by Ardaseer in his book* published in England in 1841, and many interesting details are given therein, but it will be out of place in this article to note all but a few, leaving the reader to refer to the original

It is important to note the religious prejudices which then existed even amongst Parsees, the chief of which was to take food cooked by Parsees only and not to dine with non-Parsees on the same table Hence travel to England meant expenses not only for his own but also for the servants of his caste Apart however from expense, it gave rise to other difficulties at times, mainly to find one's own apartments cooking by servants

* "Overland Journey from Bombay to England" and of "A Year's Residence in Great Britain" by Ardaseer Cursetjee

At Cairo, the author describes Ebram Pachase garden at Roda "wherein flourish all sorts of English fruits and vegetables together with the choicest East India fruits" The head gardener was an Englishman named Mc Cullock, who had been in India to collect plants for the garden

The next place of interest visited by the author was Boolak, the Northern Harbour of Cairo, and the Cotton Mills

At Alexandria, our author could not find a separate lodgement and had to stay in a room in a French Hotel in which no arrangement could be made to get his food prepared by Parsee servants and he had to satisfy his hunger by taking bread, butter and milk It was ultimately arranged by the kindness of the French Consul to have his meals prepared by a Parsee servant of a French boat

Here the author visited the dockyards and full details are given of the different workshops and of ship building He was offered a Government boat to visit the Egyptian Fleet and on reaching the first ship of the line, he was received on board with a military guard and band

Malta was reached on the 23rd October but the passengers were kept in quarantine for twenty days and were released on 12th November

Leaving that place on the 14th, he arrived at Gibralter on the 20th November

The author reached Gravesend on 2nd December and Blackwall the next day and on landing the first person to whom he paid a visit was that great friend of India, Sir Charles Forbes Bart at his residence at No 9 Fitzroy Square, London

He went to India House on the 6th, and was introduced to the Chairman of the East India Company, Sir Richard Jenkins and to the Secretary, James Cosmos Melvill

On the next day, he went and saw Sir William Symonds, the distinguished Surveyor of Her Majesty's Navy for whom he had brought letters of introduction for advice as to the future course of studies

With the approval of the Court of Directors, Ardaseer placed himself under the care of Messrs Seawards, whose works being close to the Thames, afforded him additional advantage of seeing the improvements in progress in the river and its banks

The Court of Directors granted a special allowance of Rs 300 per month over and above his salary at Bombay during the period of his stay in England

Thereafter he worked energetically, devoting all his energy to acquire qualifications as a Marine Engineer and in allied lines in different factories, visited different dockyards and obtained high compliments from all under whom he worked

During his stay in England, he made a number of calls on several retired Englishmen—men like Mounstuart Elphinstone, Lord Clare, Rear Admiral Sir Charles Malcolm, General Briggs, Francis Warden and others He had also the privilege of being introduced to Prince Albert, the Duke of Cambridge, the Duke of Wellington and the Duke of Argyll, the Marquis of Northampton (the President of the Royal Society), James Walker (President of the Institute of Civil Engineers), Sir Robert Peel, Sir John Hobhouse and others

When the address on behalf of the citizens of Bombay was presented to Sir Charles Forbes by a deputation consisting of the Right Hon Sir Alexander Johnstone (the Retired Chief Justice of Ceylon), Capt Cogen and John Romer, Ardaseer Cursetjee with his two cousins Jehangir Nowrojee and Hirjibhoy Merwanjee (who had also been in England to study further the art of Shipbuilding) was present by special invitation and Ardaseer was asked to read the address

Besides pursuing his studies in his particular subject, he got himself in touch with important institutions in engineering line Within a weak after his arrival in England, he visited the Polytechnic Institute where he spent a good deal of his time in inspecting models of various improvements in mechanical science Shortly afterwards his name was placed on the free list of members of the institute He was also elected an Associate Member of the Civil Engineers Association He was regularly attending its meetings and had earned the good opinion of its President, James Walker It was the latter gentleman at whose request Ardaseer was invited to a Soiree of the Royal Society by its President, the Marquis of Northampton at the latter's residence on 11th April 1840 at which he was introduced to his Lordship, Sir Robert Peel, the Duke of Argyll the Duke of Buccleuch and several other members of the Royal Society

On 6th May 1840 he was elected a Member of the Society of Arts and Science and in September of the same year he was appointed a Member of the Mechanical Section of the British Association

There are a few other points of interest narrated in his book which may briefly be touched here as throwing interesting light on the author's ideas on some subjects

It was strict custom amongst Parsees never to keep their heads uncovered and so when on a visit to a friend's place he saw a young Parsee boy with his head uncovered, He writes —"I was sorry to find so perfect a child as to have entirely forgotten our language and sit talking without a cap and his servant (Parsee) doing the same "

During his stay in England he never took his meals cooked by non-Parsees and on this account on more than one occasion he refused invitations to dinner from his European friends. He notes in his diary that on 25th January, 1840 Mr. Bayley, the Deputy Chairman of the East India Co. inquired if his religion would permit him to dine with him and he replied with regret that it would not and again when Meerali, the Vakeel of the Raja of Satara, invited him to dinner he sent his cook to prepare his meals beforehand. For the same reason he had to refuse with regret the invitation of the President of the Board of Control, Sir John Hobhouse, and when Mr. Walter, the Proprietor of the *London Times* invited him with his friend Mr. John Seaward to pass a few days at his house, he accepted the same but sent his servant to prepare his meals.

On visiting the Royal Mint, the author was "much disappointed as it was inferior to the Mint at Bombay."

He was fortunate enough to be present on the occasion of the marriage of Queen Victoria on the 10th February, 1840 and saw illuminations of public buildings in London which he describes as a truly splendid scene, "the most brilliant lights being jets of gas within coloured glass shades."

On a visit to the Governor of Greenwich Hospital, who was absent, he was received by Mrs. and Miss Flamming when the former presented him with a seal made from the wood saved from the wreck of the "Royal George."

He visited the Houses of Parliament on 29th June, 1840 when he saw the ceremony of administration of oath to a peer, Lord Keane and had an opportunity to listen to the speeches of the Lord Chancellor, Lord Brougham in the Lords and to those of Mr. Gladstone and Lord John Russel in the Commons.

He was presented to the Queen at a Levee on 1st July 1840. He writes:—"About 10 A.M. I called upon my excellent friend Sir Charles Forbes, who was kindly solicitous about my costume and that of my servants and about 1 P.M. Sir Charles placed his carriage at my disposal. We reached St. James' Palace and having waited for a short time I was conducted to the Presence Chamber by Sir John Hobhouse, and was formally introduced to Her Majesty, who was seated, Prince Albert standing on her left hand and the Earl of Uxbridge (Lord Chamberlain) on her right."

His views on some matters are of interest. He considered the drivers of cabs and other public vehicles "an imposing and insolvent set of men" who took every advantage, especially of foreigners and "another nuisance of London is the dirty state of the roads compared with those of Bombay."

Of shopkeepers and tradesmen he states:—"I cannot help remarking that they have generally an unfair practice of speaking against each other in the same line of business which is the cause of great embarrassment to foreigners as they cannot have confidence in dealing with them." On 1st June 1840, he received a summons to attend a Committee of the House of Commons to give evidence upon the opium question and gave it against the Opium Policy of the East India Company and he records with satisfaction that the same had approval of that tried friend of India, Sir Charles Forbes.

After completing his course of studies just when he was thinking of returning to Bombay, an advertisement appeared in the *London Times* in its issue of 10th July 1840, in which the Court of Directors invited applications for the post of Chief Engineer and Inspector of Machinery at the Steam Factory at Bombay. Thereupon Ardaseer applied for the post. After taking into consideration a number of applications received by them, the Court selected Ardaseer for the post—a no mean achievement for an Indian to successfully compete for a post with Europeans in their own homeland when no facilities were available to Indians to acquire proficiency in science.

Ardaseer returned to Bombay by the "Buckinghamshire" in the beginning of 1841 and assumed charge of his post on 1st April 1841. It is of interest to note that his appointment as Chief Engineer and Inspector of Machinery in the Bombay Dockyard led the *Bombay Times* to raise its protest and the *Bombay Gazette* to applaud the action of the Court of Directors. The former wrote:—"We doubt the competency of a native, however able or educated to take charge of such an establishment as the Bombay Steam Factory with a body of English workmen to be directed, superintended and controlled by a native." On the other hand the Gazette wrote:—"It is no small honour to the native community that the merits and abilities of this gentleman should have enabled him to carry off the prize from a multitude of competitors."

The significance of the remarks of the *Bombay Times* was due to the fact that Ardeseer was placed in charge of an establishment in which there were more than one hundred Europeans working under him.* The same authority stated that his path was not one of roses for a long time but his natural kindness soon made him a favourite with all those placed under him as he meted out justice to all irrespective of colour or creed.

He occupied the new post till 1st August 1857, when he retired from service.

His other activities may be briefly stated.

* Minutes of Proceedings of the Institute of Civil Engineers. (Vol. 51, pp. 271-74).

In 1837 he was elected a Non-Resident Member of the Royal Asiatic Society of England

When the First Freemason Lodge—the Lodge Rising Star of Western India—was founded mainly through the exertions of Mr Maneckji Cursetjee in 1843, Ardaseer Cursetjee joined it with Aga Ali Mohomed Shustree, Haji Hasam Ishfani and Mohomed Jaffer

In 1850, he was elected Vice-President of the Bombay Mechanics Institute

On 16th February 1851 he launched a steamer—"Lowjee Family" built by his son Rustomjee Ardaseer at the Mazagaon Dock It was of 80 tons The important fact to be noted in this connection is that all the materials were manufactured at the foundry he had at his residence at Mazagaon

In September 1851, he went to England for the second time for reasons of health and with the permission of the Court of Directors visited a number of cities to see the different improvements in machinery He visited America and selected various wood-cutting machines for the factory at Bombay under his charge His great hobby was to introduce novelties in the city of his birth and thus he was the first to introduce sewing machine and show its working and was foremost in introducing photography and electro-plating in Bombay He returned to Bombay in 1852

In 1855, he was elected a Justice of the Peace

The Commander-in-Chief of the Indian Navy, Sir Henry Leeke in giving publicity to the acceptance of his resignation stated —

"The Commander-in Chief cannot part with so valuable a Public Servant without an expression of the high estimation in which he holds the services of the Chief Engineer and Inspector of Machinery whom he has ever found ready by his influence and example to aid in various reforms of the Dockyard Factory "

The Court of Directors in their Despatch of the 29th June, 1858 wrote —"We have examined with great interest the Memorial of Mr Ardaseer Cursetjee in which are set forth his services for a period of 35 years in the Bombay Dockyard as well as the circumstances so creditable to himself, under which he obtained his qualification as an Engineer and in 1840, while in this country, he competed for and obtained the appointment of Chief Engineer and Inspector of Machinery in your Steam Factory which appointment he has ever since held with the full confidence and approbation of three successive Commanders-in-Chief of the Indian Navy We have resolved as a special case that he be allowed a Pension Rs 400/- a month from the date at which you have permitted him to retire "

An interesting fact to be noticed is that during the period of his employment in the Bombay Dockyard his father was Master Builder and his two sons were also employed in the Builder's Department as juniors One of his sons Rustomjee Ardaseer Wadia subsequently became Assistant Builder and retired in 1885

In 1859 he paid a third visit to England

In 1861 he was appointed Superintending Engineer of the Indus Flotilla Co at Karachi and remained there for about two years and resigned on account of his health He thereafter settled down at Richmond and passed the remaining years of his life there He died on 16th November 1877

SCIENCE IN WORLD WAR II

BINDU MADHAB BANERJEE
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INTRODUCTION

SINCE the beginning of this century, militarists and politicians have become increasingly aware of the importance of science and the scientist The phenomenally rapid improvement of the weapons of war, (beginning with the extensive use of the machine gun by the Japanese in the Russo-Japanese War), has influenced and in fact now convinced them, that without the backing of organised research on the development of existing weapons and inventions of new weapons, no major war can ever come to a successful and favourable conclusion Battles can be fought with men, materials and heroism, but to hope to win a war without war research will seem too much to even a schoolboy in this age of science

ORGANISATION FOR WAR RESEARCH

The belligerents of World War II became conscious of the necessity of war research long before the actual conflict in August, 1939 Some of them, notably Germany, made extensive preparations and mobilized a large force of scientific personnel for war research As an illustration, we shall describe the German research organisation for Air forces The activities of this organisation gave Germany unquestionably the leading position in knowledge and quality of equipment in aircraft construction till the end of war, although it is well known that control of the skies was lost long before that

This German research organisation may best be described with the help of a chart given below

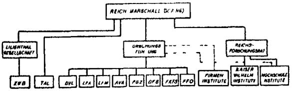

FIG 1 The German Research Organisation for Air Forces during World War II

The whole research force was in charge of Reichmarshall Goring, the supreme head of the air forces The Forschungsfuhrung (abbreviated Fo—Fu)—research leading group—consisting of four leading scientists Prandtl, Gorgn, Seewald and Baumker, actually controlled the research works carried on in eight research establishments under their guidance Each research establishment was under a director who used to exercise administrative control over the several institutes in each establishment Research work carried out in the institutes were autonomous and reported directly to Fo—Fu Each institute was headed by an institute leader guiding a group of men that actually carried on the research and experimentation Germany had a force of 6000 men working in these government owned research institutes in wartime

Besides the Forschungsfuhrung, there was the Reichforschungsrat (RFR)—the German research council It was apparently created to co-ordinate research work in the Hochuleninstitutes—about 200 research units in the different technical colleges as also the Kaiser Wilhelm-institutes In this way the whole peacetime force was brought under government control and harnessed into war work

Germany had also many research laboratories in the different industrial concerns and of munition makers, some of which were very well equipped, had extensive research facilities, and employed very capable scientists These also went in for war research under government contracts

The research department in Germany (even before the outbreak of war) constituted one of the most important and virile institutions, engaged considerable attention of the leading politicians, and consumed a good fraction of the governments income Without it, Germany could not have become so powerful militarily that it showed itself to be during World War II

SCIENCE OF DESTRUCTION

In this lecture on Science in World War II, an abstract discussion on war and its causes may not be out of place It is said that war results when peaceful methods fail When politician administrators of two or more governments go on continually disagreeing on certain important and vital matter or matters, when one, both or all of the parties become convinced that negotiation and persuasion are of no avail,—military operations, a show of force and an actual use of force becomes inevitable The parties concerned, then try to overthrow the opponent by destroying its military power, occupying important geographical positions and seats of government, disrupting civilian life and actually seizing governmental power Destruction and disruption precede and go on simultaneously with the occupation Militarists usually consider it necessary to destroy certain buildings, factories, warehouses, transport centres and transport facilities, prior to the occupation of a certain important position They also find it necessary to break the morale of the enemy by killing a good number of the opponent's military and civilian personnel However this killing frequently comes

as a bye-product of destruction and some killing must be committed to facilitate occupation as the defending party seldom vacate or disarm itself unless a good number of them are actually killed and injured

Scientific knowledge has been widely applied to all fields of military operations of which the main are (*a*) destruction and killing, (*b*) transport, (*c*) communication (*d*) reconnoisance Destruction and killing is usually accomplished by causing explosions inside or setting fire to the enemys, establishments In the main, these are done by shells fired from guns and bombs let down from aircraft Lately Rockets have in a great measure supplemented and extended the scope of operation of these weapons The chief aim of these weapons is to hurl destruction at a distance In modern warfare it is impractical to approach too close to the enemy in as much as both the parties possess weapons whereby they can kill at a distance The field guns and machine guns were the chief weapons for land warfare in World War I and their immobility led to the trench deadlock The use of tanks and aircraft as a carrier for these weapons in World War II converted the trench war of World War I into the tank war of World War II A war of patience and sniping melted into a war of action and of movements in which the rifle went out of the picture to make room for the tank destroying Bazooka rocket Destruction by bombs let down from aircraft far exceeded that ever done before by shells Infantry advanced under cover of an air umbrella, behind a spearhead of giant tanks firing heavy calibre shells while the defending party tried to put forward tanks for tank destruction and men in pillboxes and dugouts fired shells from guns and a few dare-devils in foxholes occasionally came out to fire a bazooka towards an enemy tank passing close by Attacks were followed by counter-attacks instead of mere defence and warding off the attack The fighting tactics were completely revolutionized

The chief weapons of World War II, were guns, bombs, and rockets In land warfare, they were used from tanks, armoured cars, aircraft and also by the foot soldier The actual weapons were self-propelled guns, guns of tanks and armoured cars, mortars, bombs let down from aircraft, Bazooka rockets and hand grenades from foot soldiers, rockets fired from tanks, armoured cars and army vehicles and rockets fired from aircraft A party retreating from a particular position could make use of land mines--a class of pressure-actuated bomb planted inside the earth Automatic weapons—sten-guns, bren-guns and machine guns, were also used for close range attack and defence However, they saw limited use in this war The rifle was perhaps only used by the few ill-armed guerilla soldiers and its bayonet by sentries for enforcing military rule in a territory under occupation

The chief weapons for naval warfare, were the guns, torpedoes, bombs and mines laid in strategic positions Aircraft became the chief means of delivering the attack, by means of bombs and torpedoes let down from them and guns were less frequently used The fleet became seriously vulnerable to bombing and torpedo attacks from aircraft and as a countermeasure must be protected by a naval air fleet Major operations were almost always between aircraft and the fleet, aircraft of one party trying first to destroy the aircraft carriers of the opposing party which were protected by the massed anti-aircraft guns of the whole fleet Radar came to be used almost from the beginning of the war as a detecting, range-finding and tracking instrument for gun fire control, torpedoing and even bombing The optical range finder became obsolete and the optical tracking instruments relegated to a stand-by duty Naval operations became more frequent in night time and bad whether seemed to be no obstacle to a successful operation

In this World War II, important landing operations took place The navy of the defending party had first to be destroyed, defeated or kept engaged by the navy of the invading force, when troops and equipment from merchant shipping were landed on ordinary sea beaches by the use of special landing craft and appliances and equipment converting the beach into a temporary harbour Landing operations have to face vigorous resistance from the defending land and air forces and cannot hope much success unless the latter is also completely overpowered

As in World War I, Germany's submarine force gave a different and interesting kind of naval battle The chief task of the navy is to keep sea routes open for the shipping of one's own country while closing it for the enemy A country having a powerful navy therefore tries to engage the enemies' navy and destroy it completely at the beginning of the conflict The inferior navy in that case always try to evade major engagements and is used only to escort merchant shipping sneaking supplies at opportune moments Germany used submarines chiefly to destroy allied shipping without giving fight to the allied navy The submarine could easily evade attacks from the escorting force, because it is very difficult to detect and destroy The submarine destroying weapon, depth charge, is a water blast bomb It has very little aim and a comparatively short-range The weapon of the submarine, the torpedo has a greater range, a much better aim and a great destructive power However micro-wave radar used from aircraft, ultimately spelt doom of the submarine manace, by making available a vastly improved method of detection for the submarine The submarine menace to merchant shipping was overcome, but the sub-

marine still remains an useful unit of the navy, applicable under difficult circumstances, to a variety of uses

To come to the description of the nature of aerial warfare is to come to a subject which is the most important contributing factor in revolutionizing military tactics, and also giving the common man in his home, far way from the actual warfield, a taste of modern war The development of tanks, aircraft and radio communication enabled the fighting forces utilize military tactics immensely superior to that of World War I The great military successes of Germany are mostly due to an intelligent application of this new tactics about which her opponents were quite innocent in the beginning but learned quickly Aircraft and radio has been extensively used in this new tactics of warfare and its application even modified the old conception of military strategy It is perfectly possible—now-a days to destroy enemy establishments 500 miles inside the enemy territory It is possible to regularly supply a good sized encircled force so as to maintain their fighting capacity for an indefinite period of time Aircraft gave in the hand of the military an extremely mobile piece of artillery and a very effective means of transport, reconnoisance and spying

The parties in conflict, in a modern war will first try to establish air supremacy, and a series of air-raids with important airports and adjoining towns as objective will surely occur In course of interception, bitter dogfights will be fought, and a large number of aircraft and aircraft personnel will be lost Ultimately the control of the air will go in the hands of the victorious party who will then concentrate on destroying important towns, transport and production centres, seriously hampering the country's war effort The army of the victorious party will advance and their operations will be closely supported and supplemented by aircraft Another series of air fights may occur at that time, and the defeated parties' air force will be thoroughly maimed The defending parties-and for that matter, both parties will, make extensive use of servo controlled Anti-Aircraft guns (and Rockets) aided by computing gun directors Radar will be used quite extensively but in general supplemented by optical tracking instruments, search-lights and infra-red search lights It is too easy to fool a radar now a-days !

(To be continued)

INDUSTRIAL HEALTH—ITS GROWTH AND APPLICATION IN INDIA—A REVIEW

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"INDUSTRIES in India are now of such an importance to her economic welfare and world competition has become so keen that it is necessary for Indian industries to be conducted on the most efficient basis possible To achieve this, conditions and factors detrimental to the health of the worker must be eliminated " Fifteen long years have passed since the Royal Commission on Indian Labour made these remarks (14) Factory acts were subsequently modified and extended to improve the lamentable conditions, our industries then presented Nevertheless and with a few notable exceptions, the picture has remained essentially the same The Health Survey and Development Committee appointed by the Government of India in 1944, were so forcefully struck with the gravity of the problem that they have re-emphasised the urgent need of an Industrial or Occupational Health Service to tackle the problem of the improvement of the health of industrial workers, and the problem of the health of the worker has thus once again been prominently thrown on the canvas of our post-war plans (15) As an introductory to planning in India it may be worth reviewing the growth of the Industrial Hygiene in more industrialised countries

This note is a brief survey of the historical growth of industry and particularly the industrial revolution, its consequence and reaction, the legislative counter action and finally the rise and present status of the industrial health and hygiene movement in the western countries especially Great Britain and U S A , the two most industrially advanced countries of the modern world

THE STATE AND INDUSTRY

Industry is an all comprehensive word including in its fold all types of human productive labour Since

the dawn of human civilization, man has endeavoured to modify his environment to his needs and unlike the other animals his intelligence and creative effort have been unceasingly directed for the attainment of this signal purpose. The horizon of his creative effort or productive labour has continued to expand as his intelligence has developed. Industry has thus always been the barometer of human advance. As mankind passed through various stages of evolution, beginning from the stone age to the modern age of machinery and electricity, his progress has been marked by a corresponding improvement in his industrial effort. The primary function of industry has always been to help man in his struggle of existence either against the wild animals of the jungle or his human competitors or against the elemental forces of nature, the former through the production of improved methods of offence and defence, the latter through the provision of food, cloth and other necessities to enable him to lead a sheltered and comfortable life. *Raison d'etre* of industry is therefore the wealth, health and happiness of mankind.

Organised Government and industry are the two facets of society aiming at and working for this ordered progress, welfare and safety of mankind. The value of industry in relation to its effect on the worker and through him on the society of which he forms a part is and ought to be therefore a matter of intimate concern to the State as the custodian of social interests. Under the existing capitalistic structure of society, where the right of private property has come to be regarded as sacrosanct, this relation is often lost sight of. At every grave crisis however, whenever the very existence of community of nation is jeopardised as in the last world war, the State is compelled to take over at least temporary control of industries from private ownership, proving thereby the normally latent relationship between the two, the State and industry.

The worker in industry is the most essential wheel in the industrial machinery and therefore maintenance of the health of the industrial worker is one of the primary obligations of every State, capitalistic or otherwise.

Industrial Development and its Consequence

Industry in its present form is but a growth of the last three centuries. In ancient times the production of various commodities was done on a modest scale, sometimes as a cottage industry but mostly in the houses of the skilled workers themselves. Thus before the textile industry for instance, assumed its present factory form, spinning and weaving was done either in the weaver's cottages or in the house of a small master, who acted for a group of workers, often as their selling agent. The blacksmith, the goldsmith, the carpenter or the builder, catered individually or jointly to the needs of the village or a group of villages. Life was, on the whole cheap, the worker earned enough for his humble needs, and often had his own patch of land, which served as a subsidiary source of income for his maintenance. Population was less and by the very nature of production more evenly distributed. As a result, the worker lived an open-aired contented, healthy life, often in his own hut, with local ties and local interest (4).

This more or less was the picture of Man's industrial activity from the beginning of early civilization to about the seventeenth century. The first half of the 18th century gave a fillip to industrial development in England and the West. About this time water power and later on steam power was successfully harnessed for industrial purposes and resulted in a concentration of industries in those area where water and coal were plentiful. As a result, the geographical distribution of population began to change and assume its present form. This change occurring in England, America and other western countries in the 18th century, is noticeable in India during the last fifty years. The great inventions which followed in quick succession completely swept off the small scale producer or manufacturer of the former times. The inventions of Darbys, Cort, Wilkinson and James Watt revolutionised the iron and steel industry, while those of Kay, Hargraves, Arkwright and Crompton gave tremendous impetus to textile production (7). Gone were the blacksmith and the carpenter, the weaver and spinner with their traditional associations with almost every village. In their place came the factories with their gigantic organisation and production situated at places convenient for production but not for population. These drew their labour force from widely surrounding areas, from amongst the population, most of which so long had been either small scale producers or semi-independent workers but who, no longer able to compete with the factory production and deprived of their living, had to enter the same factories as ordinary labourers. Such factories also created a demand for the labour of women and children who owing to the introduction of machinery were now able to perform work which had formerly required the physical strength of a man. The employers too preferred such labour since in addition to being cheap, it was also more amenable to control. The result of all these mechanical and power inventions was thus a wholesale migration of population from the depressed villages to a few of such industrial towns.

The towns which in consequence sprang up were unable to cope up with the new problems created and their uncontrolled growth made them hedious and

squalid In the absence of proper direction and control each city where the factories were congregated was full of filthy houses and dirty slums Because of the sudden rush of population, the avaricious landlords converted every available space including dilapidated old structures into dirty tenements and rented them to needy workers where children, women and male workers lived in filth Such tenements, in which the poverty stricken, ill-clad and half famished workers were forced to live were always dangerous centres of infection both for the inhabitants and the general population, since all types of disease—moral and physical effected their inmates (12) Conditions in the factory were not better Long working hours, low wages, insanitary and unhygienic conditions and stifling working atmosphere were the common lot of the poor industrial worker (5) And above all, apart and unconcerned with it, stood the slave driver, the acknowledged property holder and the owner of the industry, interested in making profits and bigger profits

The growth of industry has thus progressively changed for the worse of the condition of the industrial worker Some of the contributory factors for such a state of affairs, for instance, the proverty and uncleanliness, existed even before the rise of modern industrialism Industries however brought about acute congestion, deplorable living and working conditions and thus greatly accentuated the effects of poverty and insanitation

Countfraction

From the earliest times therefore industry has been more or less and directly or indirectly responsible for creating conditions adverse to or otherwise affecting the health of the community in general and its votaries in particular It is only recently however there has been a due appreciation of the important role which the industrial worker plays in the structure of human society Sincere attempts or serious effort to alleviate his suffering or improve his lot are therefore of later origin still

So long as society is based on a system of slavery and exploitation, such attempts are either non-existent or superficial Gibbon has recorded the revolting conditions under which workers and slaves, particularly the galley slaves, had to work in the ancient states of Rome and Egypt (8) The utmost that was done was to protect his life as a part of his master's property When slavery is abolished and the worker become a free citizen, he becomes entitled to State protection In practice the actual realisation of this was not achieved till the 19th century and in the wide interval that prevailed he was reduced to a condition worse than slavery itself

All the laws that were passed during this period were either in the owner's interest and if exclusively in the interest of the workers, were either ignored or exploited by the owner of the industry to his own ends and often with the connivance of the State Such was the famous ordinance of labour passed in England in 1399 compelling the worker to work on fixed low wages Such too were the statute of apprentices and the 'Poor law' passed during the reign of Queen Elizabeth (10)

The first sincere attempt in the interest of the industrial worker, was the so-called 'Health and Morals of Apprentices' Act of 1802 requiring the owners of the cotton and woolen factories to improve the working conditions of the apprentices and limiting their age and working hours (3) This act may be said to be the beginning of the present factory legislation The names of Robert Owen, Lord Ashby, Sadler, Cobbett and Whiles are closely associated with the nineteenth century struggle and efforts to improve the working conditions and the lot of the industrial worker through factory legislation Each advance had to be gained in the teeth of opposition from powerful vested interests Royal Commissions had to be appointed to institute enquiries into the labour conditions in industry Even when laws were passed the employers either ignored them or manoeuvred to circumvent them and in 1833 factory inspectors were appointed by the State in an attempt to keep a direct check on such industries (19)

Indescribably hard and revolting conditions also prevailed in the English mining industry It required a century and a half of legislative effort and the appointment of several Royal Commissions and Health Committees, 1842 1864, 1909, 1914, 1918, following the investigations of Greenhow (6) in England and of Mavrogardatto (11) in South Africa, into the evils of miners' diseases particularly silicosis to awaken the State to the existence of the grave menace that threatened its basic foundations Various mining acts have gradually been introduced strictly prohibiting the employment of women and children underground, increasing the permissible minimum age of working, controlling the working hours, improving the general working conditions in the mines and making the owner responsible for medical and compensation to the workers in case of accidents and diseases Introduction of Industrial Health insurance during the last two decades has further served to give security and protection to the worker and his family, which is their due from the community or the State (9) Finally at the instance of the Government Sir William Doveridge (2) has recently framed a comprehensive social security scheme for the worker and the present Labour Government in England hopes to put it into operation at an early date

Industrial Health and Research

The legislative and State effort for the control or amelioration of working conditions and health of the worker was half-hearted and desultory except during the 20th century Interest in the subject of industry and health can however be traced back to the days of antiquity Greek philosophers like Aristotle, Plato, Hippocrates, Herodetus and others had made a reference to the subject in their writings In the middle ages various authors like Ellenbog (1475), Agricola (1556), Panse (1614), Stockhausen (1656) and others had also left a record of their observations on the effect of fumes and gases of various kinds on industrial worker Credit for the first scientific and critical observations and record of the effects of industry or occupation on health however goes to an Italian Bernadina Ramazinni, aptly called the father of Industrial Medicine In 1700 he published his comprehensive treatise 'De Morbis Artificum Ditribe' dealing with the occupational diseases of practically all known contemporary trades The next important contribution to the subject was that of Charles Turner Thackrah who in 1831 published his survey of the health conditions in different industries and occupations The French contribution during this period was the founding of the first industrial health journal 'Les Annales d' Hygiene' in 1821 and contributions by various workers, *e g* Desavre (1956), Oliviere (1561), Bergeron (1861) and Dolpoch (1863) (17)

The dawn of the 20th century gave real impetus to the study of industrial health problems The first decade saw important contributions on 'The Dangerous Trades of Occupation' by Sir Thomas Oliver (1902 and 1908) and on the 'Effects of Gases and Dusts of various types' by Sir Leonard Hill and Haldane (1912) in England The World War I brought to the forefront the need of the maintenance of industrial output and efficiency and the consequent importance of the health of industrial workers, especially for the combatant nations In England this led to the appointment of the Health of Munition Workers' Committee (1915) Their recommendation was followed by the establishment of the Industrial Fatigue Research Board, later on designated Industrial Health Research Board to promote and direct physiological and health research pertaining to industries and to make available their findings to the worker, the employer and the State (13)

In U S A the trend of industrial health activities has been similar though on a more extensive scale The U S Bureau of Mines, the U S Public Health Service, the U S Department of Labour, the American Medical Association and different universities have all carried on important studies on the effect of industrial environment and conditions on employees, correlating these with diseases in many cases Through their effort various conferences and symposiums have been held on industrial diseases and particularly silicosis which occurs with great frequency amongst the dust inhaling workers The associations publish voluminous literature and thus help to educate the worker, the employer, the society and the authorities in problems connected with the maintenance and safeguarding of industrial health The subject has now assumed such an importance in the public eye that to-day over thirty Bureaus of Industrial Hygiene, innumerable industrial Hygiene Committees and medical societies exist for the pursuit of industrial health research These have been started through voluntary effort and co-operation by the industrial concerns and the various States

Realising the importance of the subject, Harvard University was the first in the world to include in 1918 in their curriculum, a regular postgraduate course for health personnel in a industrial hygiene and medicine and one after another, the other American universities have followed it Gradually also has come the realisation that the health of the worker is not only an asset for the community or nation but a business proposition for the employer too, since a healthy working class means higher industrial efficiency and better outturn Concrete and tangible evidence of this changed outlook was the establishment of the Industrial Hygiene Foundation of America (1935), a voluntary association of American industrialists for the betterment of the working conditions and health of the industrial population Industrial health insurance has also played a notable part in the improvement of the industrial health Amongst the activities of various such insurance companies are the free dissemination of health literature, offer of free nursing service and medical advice as also health demonstrations and exhibits Finally the mutual interest of the employer and the employee, of the former because of the various penalties and compensations he has to pay and his desire for getting maximum outturn, of the latter because of the better health and income he can enjoy, have led to the establishment in Britain and America of hundreds of industrial and mercantile health services, which keep a keen watch on the health of industrial workers

In India industrialisation is only a matter of the last fifty years Profiting from the experience of other countries, Government has already made a start in tackling the problems of industrialisation before they assume the alarming proportions which they did in the other countries Factory acts have been passed to improve the labour conditions and protect the labour A few enlightened employers like the Tatas here also cooperated in offering free

medical and some sort of sickness benefit schemes. A Royal Commission presided over by Sir John Whitley was appointed in 1931 to go into the condition of Indian labour. This has been followed recently by the appointment of Labour Investigation Committee (1944) with a view to provide adequate material on which to place a policy of social security for the labour (16). The health of the industrial worker also formed an important aspect of the survey by the Health Survey and Development Committee. The Government has also before them a scheme for the health insurance of industrial workers (1).

The investigations of these various committees have shown that our position in respect of industrial health is as yet extremely unsatisfactory. The working, the hygienic and environmental conditions in most of our industries and particularly the unregulated factories continue to be highly deplorable and with a few exceptions, medical aid for the workers is conspicuous by its absence. There is also an urgent need for investigations and research in the health problems peculiar to Indian industries and applicable to Indian conditions. Much leeway has yet to be made up to come up to the standard achieved in other countries. In view of the increasing importance of our industries in the present and particularly during the post-war period, intensive and extensive effort will have to be made to improve our industrial efficiency and hence the health of our workers.

The subject by itself however deserves an exhaustive treatment and will be treated in a separate article.

CONCLUSION

At present high mortality, fatigue, sickness, disease and invalidity are common in all Indian industries and modern research has revealed that these occur due to causes which are remediable or preventible. Industrial community forms perhaps the most important bulwark of every nation. For a nation to prosper and be strong, her industries must prosper and be efficient and for the industries to prosper, the industrial worker, who forms the central link in the chain, must be healthy. Regarded from a humanitarian, economic, social, public health or national point of view, industrial medicine and hygiene either as a social or State effort to improve the health of the industrial population—must therefore take a high precedence in every nation's and particularly India's agenda for post-war plans.

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Notes and News

31ST ANNIVERSARY MEETING OF THE BOSE INSTITUTE

The 31st Anniversary Meeting of the Bose Institute was celebrated on 30th November 1948, when the Tenth Acharya Jagadish Chandra Bose Memorial Lecture was delivered by Prof K N Bahl, D Sc (Oxon) on 'Recent advances in our knowledge of Nerves' Prof Bahl who had flown back from Beirut where he went to attend a session of the UNESCO meeting as member of the Indian delegation, first paid his homage to the memory of that great man who had not only a genius for delicate experiments with instruments specially designed by himself, but he also had the gift of masterly exposition of his scientific work to large audiences The lecturer recalled the vivid impression which had been made on him when as a young student he had attended Acharya Bose's lectures at Lahore, Lucknow and Oxford The last one was given in 1920 before a large enlightened and appreciative audience, in the magnificent lecture hall of the University Museum and was presided over by Prof Vines, Acharya Bose's former tutor in Cambridge , Prof Bahl had the privilege of assisting in the lecture The lecturer gave a very interesting non-technical account, which was illustrated by two experiments and a large number of lantern slides of the present day knowledge of the role of the nerves in the human body He discussed the mechanism of transmission by the nerves of stimuli received from the external world or from inner organs as excitation current, how it is transmitted across nerve synapses and ganglions to the brain and from there how it releases another set of impulses which are transmitted by motor nerves to the effect or muscles

In this connection he gave an account of the discovery by Loewig of a chemical mediator acetyl choline which is released at nerve endings in muscles and the subsequent experimental investigations which led to the hypothesis proposed by Nachmansohn and his fellow workers, of the role of the same chemical substance in the transmission of excitation in the nerve itself *

In the report presented to the meeting, the Director, Dr D M Bose recalled that already ten years had elapsed since the responsibility of directing the Institute had devolved on him, and he took this opportunity of reviewing the expansion of the Institute activities during the last decade In 1939 the total annual expenditure of the Institute was about rupees one lakh, half of which was met from the invested funds of the Institute and the rest from annual grant from the Central Government Last year i e , during 1947 48 the total expenditure was about two lakhs and fifteen thousand rupees which resulted in a deficit of Rs 11,000/- The government grant represented about two fifths of the total income, the Institute contribution remained unaltered, the balance of the total income was made up from receipt of grants-in-aid With the help of the latter, the Institute was able to undertake twelve separate investigations, the majority of which were of an applied character

The work of the Institute is reviewed periodically by a Committee nominated by the Central Government The first reviewing committee, presided over by Dr Dunnicliffe visited the Institute in 1940 and based on their report certain important changes were introduced in the regulations of the Bose Institute , the strength of the research and administrative staff as well as their scales of pay were fixed at the same time Neither the staff nor the scale of pay has been found to be adequate With the sudden increase in the demand for research workers created during the last war, and the subsequent rise in the cost of living, the pay offered to the staff was found very inadequate and the Institute is being continually depleted of its research staff due to this cause But for the grants-in-aid received from several outside bodies, the activities of the Institute would have been on a much restricted scale

Last March, another Reviewing Committee presided over by Prof Vallarta visited the Institute The Committee considered very sympathetically the requirements of the Institute and it is understood that they have recommended increased recurring grants both for expansion of the research staff of the Institute and for more adequate scales of pay, as well as capital grants for building and equipment purposes Their recommendations are before the Central Government and the Director expressed the hope that there will not be any further delay in implementing these recommendations, with which it is planned to make the Bose Institute an All-India Centre for training and research in Biophysics and in certain branches of Plant Sciences including Biochemistry, Physiology, and Cytogenetics

Reviewing the scientific activities of the Institute during the last decade, the Director pointed out that

* A full text of Prof Bahl's lecture will appear in a subsequent issue of SCIENCE AND CULTURE,

while some of the important plant physiological investigations of the Founder are being extended and the delicate apparatus constructed by him for such work are being utilized for applied investigations like that on the physiological requirements of economic plants like cinchona, not sufficient attention is being given, due to lack of funds, to the development of the early physical researches of the Founder, and to the utilization of the delicate instruments made by him for physical measurements These pioneer investigations dealt with the construction of a compact apparatus for the study of electromagnetic radiations, of wave length below one centimeter, and the investigation of interaction between such radiation and material systems leading to reflections, refraction, polarisation and absorption From a study of the change in conductivity of the coherers produced by absorption of radiation, Acharya Bose was led to the study of analogous changes in physical properties, including contact rectification, in other substances like galena, selenium, magnetic oxide of iron etc The interest in such study has again been revived by the use of centimeter radio waves for radar work, of crystalline semi-conductors like silicon and germanium for detection of such radiation and of contact rectifiers for conversion of A C current of frequencies upto that of visible light, and many important technical applications have been made of these discoveries This is one illustration of the well established observation that the role of a particular branch of science in the general advance of scientific knowledge and technique passes through phases of waxing and waning importance The Director gave as illustration the recent development of the Transistor of Bell Telephone Co which can replace the triode gas valve for many purposes This arrangement bears some resemblance to the coherer last used by Bose, consisting of semi-conductor metal plate with a fine metallic point resting on it In the Transistor, the semi-conductor is specially treated silicon or germanium with an additional fine wire electrode placed on it very close to the first one, between which and the plate a steady voltage is maintained

The scheme for expansion of the research activities of the Institute contains plan for furtherance of the Founder's physical investigations along with modern lines and the hope was expressed that funds may soon become available for this purpose

EIGHTH INTERNATIONAL CONGRESS OF GENETICS

THE Eighth International Congress of Genetics, held in Stockholm in July 1948, was a grand success due to the assembly of most of the eminent geneticists from all over the world * The most noteworthy absentee, at this congress as at the last (Edinburgh Congress of 1939) was Soviet Russia The most noteworthy delegate was Prof Tschermak the surviving member of the trio who re-discovered Mendel's laws The conference was held from July 7—14, preceded by excursions The credit for the success of the congress goes to Prof Bonnier, the general secretary, Prof Muntzing, the chairman of the excursion committees, and many of their colleagues in Sweden In his scholarly and brilliant presidential address that ranged far and wide on the ramifications of "Genetics in the Scheme of Things", Dr H J Muller (U S A) devoted a lengthy section to a review of some of the events in the genetics battle and to a bitter denunciation of the Soviet trend toward anti-science When the Seventh Congress was still scheduled to be held at Moscow, he revealed that one of the conditions which the Russians wished to impose was that no papers be read touching on human genetics, a condition which must be unacceptable to any conscientious man of science

With sorrowful tones appropriate to the pronunciation of the names of comrades who have fallen in the struggle for what they believe right, Muller read the honor roll of those martyred Russian geneticists, headed by the illustrious N I Vavilov, who have disappeared without a trace The various papers that were read and discussed covered the whole field of genetics including the following main topics

(i) *Human genetics*—twin studies, blood groups, genetics of diseases
(ii) *Animal genetics*—colour inheritance in mammals and birds, mouse genetics mouse physiogenetics cattle genetics, animal psycho-genetics, animal cyto genetics, environmental control and gene expression in *Drosophila*
(iii) *Plant cytogenetics*
(iv) Chromosome structure and movements, numerical chromosome variations supernumerary chromosomes
(v) Nuclear physiology physio genetics
(vi) Artificially induced mutation polyploidy
(vii) *Population genetics*—wild animal populations plant genetics and evolution
(viii) Quantitative inheritance, non euchromatic inheritance, genetics and species problem
(ix) Gene analysis in micro organisms, linkage and gene analysis
(x) *Genetical mathematics*

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* Auerbach, Bateman, Black, Catcheside, Crane, Darlington, Fisher, Haldane Hutchinson, Knight Manton, Mather, Philp, Pontecarvo, Race Sansome, Yates from Great Britain, Kostof from Bulgaria Newcombe from Canada, Tan from China, DeCognac from France, Tischler from Germany Schulte and Sirks from Holland, Love from Iceland, Jucci from Italy, Kihara from Japan Gajewisk from Poland, De Camara from Portugal, Akerman, Bonnier, Caspersson, Gustafson Johansson, Levan, Muntzing Nilsson, Rasmusson Von Rosen, Turesson from Sweden, Beers, Clausen, Demerec, Dobzhansky, Goldschmidt, Keeler, Swanson, Valencia (J & Marie) from U S A Tschermak from Vienna, five Indians including Dr S N Dasgupta (UNESCO) were present

(xi) *Serological genetics*
(xii) Principles of applications within the field of genetics

Demerec in his paper on the chemical mutagenicity (in *Drosophila*) of carcinogens and related non-carcinogens belonging to the hydrocarbons and azo groups, stated that there was a correlation between the mutagenicity and the carcinogenicity Auerbach, investigating on the mustard gas mutations of *Drosophila*, stated that the mutations occur in all regions of the X-chromosomes

Dealing with the different races of *Drosophila pseudo-obscura*, Dobzhansky pointed out that the different races have different frequencies of various gene arrangements in the third chromosome Clausen, in his paper on the genetic of climatic races of *Potentilla glandulosa*, stated that the different ecological races of this species depend upon sixty to hundred genes at the minimum for their different morphological and physiological characters, and that genetically there was no essential difference between the physiological and the morphological characteristics of the races

Goldschmidt discussing the "podoptera effect" in *Drosophila* agreed with Mather's theory that the polygenes are located in the heterochromatin and stated that the heterochromatic mutation was very important for evolution

Muntzing revealed the presence of a "standard fragment" (in Rye) which is not homologous to and less active than any of the ordinary chromosomes and which, when present in high number, affect the fertility and vigour of the plant He also discussed the behaviour of the accessory chromosomes at meiosis in *Poa alpina*

Mather stated that the continuous variation in a character was due to the effect of the similar members of a polygenic system Kostoff dealt with the details of production of *Nicotiana tabacum* var *viru*, which he is now largely using for crosses due to its resistance to common tobacco mosaic virus

Jucci described the interesting work on silkworms which he and his colleagues are doing in Italy

Kihara's paper on the synthesis of hexaploid wheat was of great interest In this connection DeCamara pointed out that the importance of *Aegilops squarrosa* in the production of hexaploid wheat was first pointed out by Pathak from India in the International Congress of Genetics held in Edinburgh in 1939

There was a very interesting discussion on the necessity of establishing an international organisation for the cataloguing, maintaining, and exchanging of the genetic stocks A committee was set up to prepare a report on this matter to be sent to the FAO for necessary actions

The next congress will be held after four years in 1952 and is likely to be held at Rome (Italy)

THORIUM IN NUCLEAR FISSION

THE Atomic Energy Commission, Washington, D C, has outlined the nature and extent of its present interest in Thorium By the Atomic Energy Act of 1946, thorium like uranium was placed under the control of AEC, and a strict control of export and a complete record of domestic movements of Thorium-bearing materials, including monazite ore, has been maintained by the Commission So far as the Commission's programme is concerned, the usefulness of thorium and its principal source in nature, monazite ore, is limited for the present to research Accordingly, the only Thorium the Commission purchases is for experimental purposes, chiefly in the form of Thorium salts, and the Commission has no facilities for employing monazite ore

Since monazite ore is the only commercial source of the element cerium and other rare-earth materials which are essential to many industries, current demand for this arises principally outside the atomic energy (*The Chemical Age*, November 13, 1948)

REACTIONS IN ATOMIC PILE

IN a recent lecture delivered under the auspices of the Oil and Colour Chemists' Association, Professor Emeleus discussed about the experimental study of radioactive substances Tracers are produced in the cyclotron or the pile In the pile, which consists of U^{235}, U^{238} and pure graphite moderators, the U^{235} undergoes fission and yields neutrons These, originally fast, are slowed down by graphite Some produce fresh fissions, some are captured by U^{238} and produce Pu For the production of tracers, samples are placed in graphite blocks and slide along channels into the pile The products are handled by the technique of microchemistry and with great attention to health precautions The unit of radiation is the Curie representing α activity equivalent to 1 gm of pure radium or 3.7×10^{10} particles per second This is a large unit and the milli- and micro-curie are more usual At the curie level, the laboratories are considered "Semi-hot" and are equipped with special screening and air ventilation with provision for purifying the air In the isolation of plutonium and of other radioactive products of the atomic pile, the radiations cause some decomposition in the reagents used, such as solvents In the cooling water, moreover, dissolved air may yield oxides of nitrogen and nitric acid causing corrosion of the pipe work The graphite itself expands due to a change in the lattice, this cause a progressive mechanical weakening of the pile The question has been raised whether technical synthetic use may be made in industry of these chemical effects Could, for instance, ammonia be synthe-

sised simply by passing its constituent gases through channels in the pile? Research is in progress on these and other similar problems (*The Chemical Age*, November 13, 1948)

ATOMIC ENERGY EXHIBITION

AN exhibit on atomic energy, entitled "Atomic Energy is Here for Good" has been presented in the Museum of the Franklin Institute, Philadelphia, during the months of November, December, and January (1949) The exhibit, which explains atomic energy on a non-technical level by demonstrations, models, displays, panel illustrations and photomurals, is sponsored by the Brookhaven National Laboratory, under the auspices of the A E C

Featured in the exhibit is a model atomic pile which splits single uranium atoms before the eyes of the spectators Energy released by this fission process is amplified into visual and sound effects A tiny capsule of a mixture of radium and beryllium is used in the model to produce the neutrons that pierce the nuclei of uranium atoms in the fission chamber

The power possibilities of nuclear energy are demonstrated in a model power plant showing how an atomic pile may be employed in future to generate electric power The great heat release resulting from nuclear fission may be transformed into steam to drive electric generating machinery A striking feature will be the radioactive flower, growing in soil fertilized by a phosphate containing radioactive phosphorus A Geiger counter is used to demonstrate the course of "tracer" atoms into the roots, stem, leaves, and flowers of the plant A miniature Van de Graaf electrostatic generator is one of several scientific instruments demonstrated A Wilson cloud chamber shows the paths made by atomic particles in a pressure chamber containing an atmosphere of fog (*Journal of the Franklin Institute*, October 1948)

SCIENCE AND INDUSTRY

THE 110th Annual Meeting of the British Association for the Advancement of Science was held at Brighton during September 8-15 last, Sir Henry Tizzard, President of the Association spoke on "The Passing World" in which he reviewed some of the outstanding features of the progress of science and technology in Great Britain from the close of a period of stagnation towards the end of 19th century

Speaking on the subject of application of science to industry, Sir Henry brought out the need to apply research results, as opposed to the intensification of research, by citing the examples of building and cotton

"The Shirley Research Institute for the cotton industry is well known for the range and excellence of its work, but productivity in the cotton textile trades is lower than it was fifteen years ago and much lower than in some other countries Taking British industry as a whole, productivity is far lower than in the United States In both countries about 40 per cent of the population is gainfully employed In the United Kingdom the proportion engaged in manufacturing, building and civil engineering, which covers the production of all capital and consumer goods (other than minerals or food) is now a little less than 18 per cent of the population In the United States the corresponding figure is 12 per cent, and yet in proportion to the population the volume of production is far higher than in the United Kingdom"

Continuing Sir Henry observed "The causes of the relative productivity and wealth of nations are, of course, many and complex We gained our supremacy in the nineteenth century because we excelled in engineering genius and were the first to use mechanical power on the large scale for manufacture and transport Our population grew rapidly because we were prosperous, and it paid us to become a good importing nation because the productivity of labour in the secondary industries was so much higher than in agriculture But conditions have changed in the course of time We no longer have any outstanding natural advantages, and we must expect that given approximately equal skill in technology other nations with greater natural advantages will surpass us Only by maintaining leadership in the application of science can we hope to keep our position among the great nations So it is not surprising that the United States, and Canada, for example, with their great natural resources, and abundant supply of cheap power, should have passed us in wealth and productivity before the War It would have been surprising if they had not But it is by no means so easy to explain why Switzerland, which in 1885 possessed a national income per head about two thirds of that of the United Kingdom, should have equalled us in prosperity by 1939, or why the industrial productivity of Sweden, a country that has no coal, should have been rising so much more rapidly than ours in the years between the wars These two countries cannot be said to possess natural resources superior to ours, nor can it be argued that in the quality or quantity of scientific and industrial research they excel us But I suggest that they, in common with the United States, possess a higher average standard of technology than we do, and have a much greater proportion of men of high scientific education in executive control of industry I quote them in support of my

view that it is not the general expansion of research in Britain that is of first importance for the restoration of its industrial health, and certainly not the expansion of Government research remote from the everyday problems of industry What is of first importance is to apply what is already known "

X RAY MICROSCOPE

For the examination of minute objects not readily penetrated by light or electrons, an X-ray microscope has been developed by Paul H Kirkpatrick of Stanford University While it will not have the magnifying power of the electron microscope, it will be much simpler in construction and will offer the advantage that living specimens can be examined Since objects examined under a beam of electrons have to be in a vacuum, this dries up and kills living tissues Dr Kirkpatrick hopes that fully developed models of the device will permit the X-raying of objects less than a millionth of an inch in size, or about 20 times smaller than can be seen with an optical microscope using short wave light

An X-ray microscope had long been considered an impossibility because X-rays show almost no refraction, and because of a peculiar quality of the rays which makes it impossible to reflect them off anything except at a very low angle

For successful microscopic X-rays, special tubes are required which will produce more of the "soft" X-rays—those with a longer wavelength Dr Kirkpatrick and his staff drew on two well-known facts about light phenomena for their research that X rays would reflect at a low critical angle and that the use of two lenses would concentrate diffused rays He bounces the X-ray off one mirror, set up vertically, to another reflector, which is horizontal One mirror brings the X-rays together on a horizontal plane, the second brings them together on a vertical plane The mirrors are slightly concave Still better optical surfaces will have to be developed to secure anticipated maximum results An alloy of nickel and platinum has been used as coatings for the mirrors It is suggested that the X-ray microscope may be useful in the field of metallurgy, in the study of crystals and in various biological sciences (*Chemical & Engineering News*, October 11, 1948)

SYNTHETIC RESINS IN PAPER MAKING

An investigation on the use of synthetic resins in offset printing papers has been carried out in a semi-commercial-scale papermaking plant at the National Bureau of Standards The use of melamine-formaldehyde has been found to improve paper strength and printing properties and to permit the use of short, weak hardwood fibres in papermaking The technique consists essentially in substituting synthetic resin bonds between the fibers for the gel-like bonds formed by hydration The resin bonding gives optimum strength and produces a superior paper by elimination of the adverse effects of hydration For normal commercial fibre combinations it was possible to develop as much strength with 2 per cent of resin and no beating as with 9 5 hours of beating without resin

In the use of deciduous wood fibres such as birch sulfite and aspen sulfate, the addition of 1 to 3 per cent of melamine formaldehyde resin increased resistance to surface picking and folding endurance more than 10 times in some instances (*Chemical & Engineering News*, October 25, 1948)

SCIENTIFIC FILM CONGRESS

A Scientific Film Congress was held in London, in October last at which delegates and observers from 25 countries and UNESCO accepted invitation

The Congress decided upon a programme of work for the coming year which includes

(1) The establishment of an international data card for compiling a master index of Scientific Films available throughout the world and the formulation of methods of appraisal of these films,

(2) The joint production, by a number of countries, of films of common interest,

(3) The exchange and distribution on the widest scale of scientific films and the customs regulations affecting such exchange,

(4) The setting up of a Scientific Film reference library, and

(5) The exchange of information between nations by means of a regular journal

Further information may be obtained from the Scientific Film Association, 34 Soho Square, London W 1

SCIENCE AND TECHNOLOGY IN CHINA

The Natural Science Society of China (C/o National Central University, Nanking, China) has inaugurated a new journal *Science and Technology in China*, a bimonthly publication in English devoted to first hand reports on developments in the fields indicated in the title There are six issues a year, to appear on the first-days of February, April, June, August, October and December

Science and Technology in China is in spirit a continuation of *Acta Brevia Sinensia*, published during the war years by the Society in co-operation with the British Council in China It has a much wider

scope and includes, besides abridged reports of original research, articles reviewing progress in various fields, reports on scientific and technological institutions and learned societies, biographical notes, book reviews and news in brief

INDIAN COTTON BEFORE AND AFTER PARTITION

As a result of the partition of the country, the Indian Union's share of undivided India's production of cotton of staple length ⅞″ and above, below ⅞″ and above 11/16″ and 11/16″ and below forms 45, 62 and 76 per cent respectively, on the basis of the figures for 1946-47 The Indian Union's output of cotton of staple length 1″ and above forms about 33 per cent of that of undivided India The present production of cotton of staple length '⅞″ and above' and 'below ⅞″ and above 11/16″', in the Union should be raised by at least 80 and 39 per cent respectively, to meet internal requirements in so far as Indian and Pakistan cottons are concerned The production of cotton of staple length 11/16″ and below at the current level is just sufficient to meet internal demand It is possible to attain self-sufficiency, in the immediate future, in regard to the requirements of mills in the Indian Union in respect of Pakistan cotton, except perhaps for a moiety of the 2 lakhs bales of staple length 1″ and over at present being obtained from Pakistan, provided the food position permits of an increase of about 4 million acres in the area under cotton as compared with 1946 47 when the acreage was 11 5 millions (*The Indian Cotton Growing Review*, October, 1948)

FORTHCOMING SCIENTIFIC AND TECHNICAL CONFERENCES AND CONGRESSES

Date of Conference	Title of Conference	Name of Convening Body	Place of Meeting
1949			
January	Winter Meeting	British Grassland Society	Newcastle
Feb 2 23	7th Pacific Science Conference	Royal Society of New Zealand	Auckland and Christchurch
Feb 8 onwards	International Civil Aviation Organization, Air Line Operating Practices Operations Division	International Civil Aviation Organization	Montreal
Feb 22 onwards	International Civil Aviation Organization Airworthiness Division	International Civil Aviation Organization	Montreal
May 16 -June 3	U N Scientific Conference on Conservation and Utilization of Resources	ECOSOC	U S A
May	International Railway Congress	International Railway Congress Assoc Brussels	Lisbon
June 14—16	Committee on Science and its Social Relations	I C S U	Paris
June 20 25	International Conference on Scientific Abstracting	UNESCO	Paris
July	Summer meeting	British Grassland Society	S E England
July 9-23 (Proposed)	4th Empire Mining and Metallurgical Congress	Empire Council of Mining and Metallurgical Institutions	London & Oxford
July 21—29	2nd International Congress of Crop Protection	International Union of Chemistry	London
July	Commonwealth and Empire Conference on Tuberculosis	National Assoc for the Prevention of Tuberculosis	London
Summer	Congress of Psychotechnics	National Institute of Industrial Psychology	Berne
Aug 15—19	12th International Dairy Congress	International Dairy Federation	Stockholm
Aug 19—25	1st International Biochemical Congress	Biochemical Society	Cambridge
Aug 31—Sept 7	British Association for Advancement of Science Annual Meeting		
Aug and Sept	Specialist Conference on Plant and Animal Nutrition in relation to Soil and Climatic factors	Council for Scientific & Industrial Research (Australia)	Australia
Sept 6—10	15th General Conference	International Union of Chemistry	Amsterdam
Sept 14—16	General Assembly	International Council of Scientific Unions	Copenhagen
October	The 5th International Animal Husbandry Congress (Zootechnical)		Paris
October	The 7th Pacific Science Congress		
Undecided	3rd International Conference on the Chemistry of Cements	Bureau of Standards	Washington
Undecided	Conference on Cosmic Rays	Cosmic Ray Commission of the International Union of Physics	Europe
Undecided	6th International Congress on Radiology		London or Cambridge
Undecided	5th International Grassland Congress Date and Programme not yet fixed		Netherlands

MEXICAN ELECTED DIRECTOR GENERAL OF UNESCO

DR JAIME TORRES BODET, Foreign Minister of Mexico, is elected the new Director-General of the United Nations Educational, Scientific and Cultural Organisation

Dr Bodet, born in Mexico on 17th April 1902, received his education in that country An eminent author, and former Minister of Education in Mexico, he has written three volumes of poetry, six novels, and many books on education For his outstanding work in the educational field, the University of Mexico and the University of Southern California conferred on him the honorary title of Doctor in Letters He is also an active member of the Mexican Academy of Languages While with the Ministry of Education, Dr Bodet organised a system of public libraries throughout Mexico, and assisted in the translation of the classics which were published by the Mexican Government He was Professor of French Literature in the Department of Philosophy and Letters in Mexico from 1924 to 1928

He entered the Foreign Service in 1929 and held diplomatic positions in Spain, Holland Belgium and France

In 1943 he was appointed Minister of Education, at which time he initiated the world famous Mexican campaign against illiteracy In November 1945 he headed the Mexican delegation to London, and attended the Conference which created UNESCO He was one of the original signers of the UNESCO Charter

He has been Foreign Minister of Mexico since December 1946, and in that capacity led the Mexican delegation to the Inter American Conference for the Maintenance of Peace He was also head of the Mexican delegation to the Second General Assembly of the United Nations, where he was elected Vice-President

Dr Bodet will assume his duties as Director-General of UNESCO in Paris at the beginning of 1949

INDIAN INSTITUTE OF CHEMICAL ENGINEERS

THE Indian Institute of Chemical Engineers was inaugurated in December 1947 at Patna by Dr Hira Lal Roy to help the advancement of the profession and science of Chemical Engineering

Dr Roy in his presidential address stressed the need for a co-ordinated effort to standardise the teaching of Chemical Engineering in various schools and colleges of the country and presented the Institute with a careful analysis of numerous courses in Chemical Engineering in the United States of America, the United Kingdom and Europe

Since January 1948, a number of meetings were held in Calcutta where the office of the Institute is temporarily located, and the members had the opportunity of reading and discussing Papers on Chemical Engineering subjects

The Institute has a membership of over hundred Engineers in 1948, the very first year of its life

The first Annual General Meeting and Second Paper Session of the Institute will be held at Allahabad in January 1949 at the Indian Science Congress Session and numerous papers on vital problems of the Chemical Industry of the country are to be read and discussed at that meeting

ANNOUNCEMENTS

SRI KAMALESH RAY, has recently returned after qualifying himself as an Engineer from the U S A Readers of SCIENCE AND CULTURE are well acquainted with Ray's widely read articles on the Damodar Valley Planning and similar ones of national importance Sri Ray was the recipient of the Ghose Travelling Fellowship of the Calcutta University, Watumull Foundation Scholarship and a Scholarship from the Government of West Bengal Along with his studies in Civil Engineering with special reference to Hydraulics, Sri Ray has also studied Soil Mechanics and Geology for better understanding of the river problems He has visited most of the important river projects and hydraulic laboratories, including those of TVA, Bureau of Reclamation and some in England and in Switzerland

SRI PRATUL CHANDRA MUKHERJI, Junior Research Fellow National Institute of Sciences of India has been admitted to the degree of Doctor of Science of the University of Calcutta for his investigations on the synthesis of Steroid sex hormones and Sesquiterpenes His thesis has been adjudicated by a Board of Examiners comprising Prof Sir Robert Robinson, Prof Sir W N Howarth, and Prof L F Fieser

THE Royal Commissioners for the London 1851 Exhibition will award in 1949 for study abroad one science research scholarship to an Indian student having Post-graduate training in Science, with capacity for original scientific investigations The value of the scholarship is £350 per annum and tenable for a period of two years

Subjects of the Dominion of India below 26 years of age on 1-5-1949 will be eligible for the scholarship Applicants have to forward their applications by a University or an Institution through the Provincial Government to the Ministry of Education, Government of India before 10-2-1949

DR ELMER D MERRILL, Director Emeritus of the Arnold Arboretum of Harvard University, has been made an Officer in the Netherlands Order of Orange Nassau in recognition of his contributions to the knowledge of the Malaysian Flora, his stimulating interest in Dutch and Indonesian botany, and his efforts to promote international co-operation in botany

The award was made in a ceremony at the Netherlands Consulate in Boston in the presence of Mrs Merrill and Dr Frans Verdoorn, who represented the biological institutions of the Netherlands Indies

BOOK REVIEWS

Principles of Radar—By Denis Taylor, Ph D, and C H Westcott, Ph D Published by the Cambridge University Press, Cambridge Price, 12*s*, 6*d*

In recent days, the attention of every student of Physical Sciences has been focussed on Radar, for its immense success in the last World War But common readers, engineers, physicists or mathematicians find the sudden release of so much detailed information about radar to be perplexing, and consequently have felt an urgent need for a treatise on the introduction to such a highly technical subject In the "Principles of Radar" the authors have successfully presented the common factors underlying the many complicated types of radar equipments

The treatise, as the name signifies, deals only with the principal concepts of radio location and naturally the exposition of the intricate electronic circuits involved therein are not discussed in this In the eight chapters, excluding the general information, the treatise deals with generation and reception of pulse modulated signals, performance of radar equipments, radar ranging, determinations of azimuth and elevation, unwanted echoes, and secondary radar

The pulse modulated signals and the associated receiver characteristics have been studied in two chapters in a most comprehensive manner Extensive information on the Fourier analysis of pulse form, the noise factor, the antenna gain, the ground absorption, and echoing-area-considerations have been creditably condensed, without sacrificing the mathematical basis of the whole survey The propagation characteristics and the consequent choice of frequency range have been amply described before striking at the ranging problem in two dimensions

The information on radar ranging, determination of elevation and azimuth, either separately or jointly, by pencil-beam radar scanning have been dealt with using fundamental concepts, but the mathematical basis of the electronic appliances used therein does not figure in the treatment The general difficulties encountered in the centimeter radar practice, *e g*, the sea clutter, the ground clutter, the difficulties in callibration on account of Doppler effect have been clearly stated and explained The disadvantage of operating a secondary radar system for working I F F has also been discussed The two appendices containing the formulae for ready reference, and also the fundamental computations for the echoing area of conducting objects and others,—are also very useful No doubt the book serves as a good exordium to the vast knowledge opened by radar

S C

The Evolution of Modern Physics—By C T Chase (Van Nostrand, New York) Macmillan, London, 1947 12 Illustrations Pp x+203 Price 14*s*

This book is a survey of almost the entire field of physics from the old times to the modern days The book has a charm of avoiding mathematics from beginning to end, and to non-technical readers this comes as a great relief who wish to read, but reluctantly avoiding reading books relating to modern physics

The book is a storehouse of information to those who want to know something about the developments that made the appearance of this 'atomic age', they acquaint themselves with almost all the aspects that are characteristics of the present day atomic physics, yet it appears from a careful survey of the book that the right things are not always treated in the right order Nevertheless, it is a very pleasing book for youngsters and aspirants of knowing something of physics

The first two chapters deal with the old science of kinematics built up by the consistent effort of the

great past savants who paved the way to a easy approach to the proper understanding of the laws of nature Chapter 3 and 4 discuss the much talked of topics as to the concepts of the nature of light varying from time to time, and the classic works of identification of heat as motion and energy Chapter 5 deals with molecules and that part of physics which merges naturally into chemistry

Chapter 6 nicely presents the researches of Faraday and others in the realm of electromagnetism and the author deserves credit for giving Faraday the important recognition he deserves Chapter 7 begins with classical works of Maxwell and Hertz and terminates in the successful operation of Radar

Chapter 8 on cathode rays and x rays are treated in a formal way without much details, but the author truly concludes "The seeds of modern physics have been sown It was to grow by leaps and bounds, no sooner appearing ripe for harvesting than new spurts would send physicists hastily into fields, eagerly watching their crops and wondering what next development turn out to be"

Chapter 9 deals with the work of Curies on radioactivity, and chapter 10 with the "Rutherford atom" Isotopy is also treated Chapter 11 on the quantum theory is not quite impressive and chapter 12 on spectroscopy deals with the "Bohr atom" The importance of the transition from "Rutherford atom" to "Bohr atom" is not adequately stressed, though the works of Sommerfeld, Von Laue and Moseley are mentioned The works of Schrodinger and Dirac in this field must not have escaped the author's careful mind

Chapter 13 on relativity and chapter 14 on the velocity of light is well written especially on Michelson's wonderful series of experiments on the latter chapter is worth notice

Chapter 15 and 16 deal with Millikan's work on the determination of electronic charge and on photo-electricity respectively, and a due place for "Compton effect" and "Raman effect" is incorporated

In chapter 17 on "electron waves", Davisson and Garmer's work finds rather more space than it deserves, compared to those of G P Thompson, Rupp, Kikuchi etc Wave mechanics is treated in Chapter 18 in a vague way

Chapter 19 on atomic nucleus presents earlier experiments nicely and chapter 20 on the release of atomic energy, the most talked of topic of the present day is rather treated in a 'mild dose' This chapter should have been given more attention to, but the writer satisfied the readers only by naming the 'Smythe report' Americium and Curium are not mentioned

While the book makes an interesting reading, it appears that the American School of thought has been given a bit much more attention to than it fairly deserves However, when it is recalled that the object of the writer is to present physics to a none-too-serious reader, and the avoidance of mathematical reasoning has been persistently adhered to the author is welcome in writing this beautiful monograph

A C

Geology of the Lizard and Meneage (Memoirs of the Geological Survey of Great Britain, England and Wales)—By Sir John Smith Flett, K B E, LL D, F R S Second Edition, 1946 Published by His Majesty's Stationery Office, London, 1946, Pp 1-208 21 Text figures Plate i-ix Price 7s 6d

The Lizard area has already been surveyed in detail by the official Geological Survey twice, first by De la Beche, the first Director of the Geological Survey of Great Britain, England and Wales in 1839, and then by Flett and Hill in 1912, and from time to time by other geologists The present edition, revised after retirement by Sir John Flett, the senior author of the earlier edition (1912), summarises the progress that has been made since 1912 The Memoir proves, if indeed such proof be called for, that the geological survey of a terrain can ever be final We may well bear this fact in mind in India so that there need be no apology for re-surveying parts of the country in the light of recent data

Metamorphic schists and gneisses with intrusion of serpentine, gabbro and basic dyke, often highly metamorphosed are typical rocks of the Lizard area, the oldest being mica-schists, quartz-granulites and green schists, the last probably of volcanic origin

The Kennack gneisses which "have given rise to most controversy" in the geology of the Lizard have been fully described A major part of the banded gneisses, the author thinks, has been produced by the "reaction of acid rocks on basic material" Various types of gneisses are mentioned and their origin discussed The author has established that the Kennack gneisses are intrusive into the serpentine, gabbro and "black dykes" and that they contain numerous inclusions of serpentine and gabbro Banded character of the gneisses is ascribed to "fluxion" in a heterogenous magma

The Lizard Boundary is believed to be perfectly definite line, the position of which can be easily and sharply located, where the line is straight, it is probably a fault but at places it is gently curved and is "presumably a thrust"

The important metamorphic features, including "thermoplastic" type of metamorphism in mica-schists and green schists, and of the famous serpentine mass of the Lizard are fully discussed

In this edition the recent researches of Miss M L Hendriks and Prof W H Lang have been incorporated It is stressed that Hill's Devonian Portscatho and Falmouth beds cannot be separated and that possibly they are on the same horizon as the Grampound The Mylor beds are considered to be continuous with the Gramscathos

Dr C J Stubblefield's recent identification as *Chonetes* of what had previously been described as *Orthis* in the Meneage quartzite establishes the Lower Devonian age of the Meneage breccia The Meneage breccia is the result of the Hercynian earth movements which took place at the close of the Carboniferous time due to folding and faulting of rocks of Cornwall and Devon during which the Carnmenellis granite was injected producing a zone of thermal metamorphism around it

The recent contribution on the Carnmenellis granite by Dr P K Ghosh has been quoted to indicate successive intrusions of granite in the area and of the dome shaped nature of the Carnmenellis granite and the behaviour of the *Killas* inclusions in the granite magma In the end a few pages have been devoted to describe the economic minerals of the district

The Memoir contains numerous sketches and photographs and a complete and up-to date bibliography which makes it all the more attractive to readers It can be said without doubt that this edition is an important contribution to the advancement of knowledge of the complex problems of the Lizard geology and is worthy of the author, the late Sir John Flett, whose "devotion to the furtherance of the science which he served so long and so faithfully" led him to undertake the work even in his retirement, and which was published shortly before his death

T C B

LETTERS TO THE EDITOR

[*The Editors are not responsible for the views expressed in the letters*]

MANUFACTURE OF ELECTRICAL MEASURING INSTRUMENTS

One important aspect was not dealt with in my article[1] published earlier, *e g* , capital required in such industries

The demand unlike other electrical machineries like fans etc varies a great deal and consequently though the price of an individual instrument is quite small the total capital involved in the manufacture of these instruments is very large as worked out below

(*i*) Kind Voltmeter, Ammeter, Milli-Voltmeter, Milli-Ammeter = 4

(*ii*) Type Moving Iron (M I), Moving Coil (M C), Hot wire (H W) and Thermocouple (Th C) = 4

(*iii*) Size 6″ dial, 5″ dial, 4″ dial, 3″ dial and 2½″ dial = 5

(*iv*) Pattern Switch Board—(*a*) Projected mounting, (*b*) Flush mounting and Portable Pattern = 3

(*v*) (*a*) Ranges in voltmeters—6, 10, 12, 15, 20, 25, 30, 50, 60, 75, 100, 150, 250, 300, 500 and 600 = 16

(*b*) Ranges in Ammeter—1, 5, 10, 20, 25, 30, 50, 75, 100, 150, 200, 250 and 300 = 14

(*c*) Ranges in Milli-amps—1, 5, 10, 15, 25, 50, 100, 200, 250 and 500 = 10

(*d*) Ranges in Milli-volts—50, 100, 200, 250 and 500 = 5

For simplification putting them in tabular form we have

Type	Size	Pattern	Range
Voltmeter 2 (M I & M C)	5	3	16
Ammeter			
(*a*) 3 (M I , M C & Th C)	5	3	14
(*b*) 1 (H W)	5	3	7
Milli ammeter			
(*a*) 2 (M I & M C)	5	3	10
(*b*) 1 (Th C)	5	3	8
Milli Voltmeter (2 M I & M C)	5	3	5

Leaving aside Polarised type meters (suitable for charge discharge of current), Electro-Static Meters, Micro-Ammeters, Galvanometers, and double, triple and multi range meters and supposing instead of 3 or 4 grades, instruments of only one grade *e g* ,

first grade is manufactured even then if only one meter of each type, size, range etc is stocked, the total number becomes

$$2\times 5\times 3\times 16+3\times 5\times 3\times 14+5\times 3\times 7+2\times 5\times 3\times 10+5\times 3\times 8+2\times 5\times 3\times 5$$
$$2\times 5\times 3\ (16+10+5)+5\times 3\ (3\times 14+7+8)$$
$$=930+855=1785$$

If only a dozen meters (which is a very moderate figure) of each type, size, range, etc is kept in stock the total number becomes 21,420 Taking average price of a meter at Rs 50/- the total sum involved becomes Rs 10,71,000/- (Rupees ten lakhs seventy one thousand) and to keep a stock of fifty numbers of each type, size, range, etc the finance involved is nearly Rs 45,00,000/- (Rupees Forty-five lakhs)

If the cost of semi-finished instruments and component necessary for continuity of production and the cost of equipments for storage, leaving aside the cost of machinery and factory equipments, are added, the total capital involved becomes a very large figure

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[1] SCIENCE AND CULTURE *12* 275, 1946

ACACIA CHUNDRA OR *ACACIA SUNDRA*?

IN an earlier communication,[1] it was pointed out, in passing, that the correct name should preferably be *Acacia chundra* At the time of publication I was aware that an explanatory note would be necessary, as the other name (*i e*, *Acacia sundra*) has gained some popularity in India I intend to discuss this point in this note The rules of nomenclature (Art 70) allow a change at a later date, if it could be proved that at the time of publication the original author made a "clearly unintentional orthographic error" In this particular case, at the time of valid publication of the names *Mimosa chundra* or *Acacia chundra* by Rottler and Willdenow respectively, there is no doubt that the epithet *chundra* was used deliberately, and as such, the name *Acacia chundra* should be accepted The correct name is given below, followed by synonyms which are arranged in chronological order

Acacia chundra Willd Sp Pl *4* 1078 (1806)
Mimosa chundra Roxb ex Rottl in Gesel Naturf Freund Berlin, N S *4* 207 (1803), Willd Sp Pl *4* 1079 (1806) in syn
Chundra Acacia Willd l c (1806) *nomen*
Mimosa sundra Roxb Cor Pl *3* 19 et tab 225 (1819)
Acacia sundra DC Prod *2* 458 (1825)

It will be evident from a study of the synonyms that on grounds of priority the epithet *chundra* has to be accepted unless it is an orthographic error The plant was collected by the German missionary Rottler from a place called Marmelon (near Madras) on October 9, 1799 This plant was described and validly published with a Latin description in 1803 (*l c*) Three years later, Willdenow transferred the name to *Acacia chundra* (*l c*) It is interesting to note that at the time of publication, Willdenow knew that the plant was described earlier by Rottler as *Mimosa chundra*, and he (Willdenow) used the epithet *chundra* three times in course of a few lines (*l c* 1078-79) Moreover, Willdenow had no knowledge of the other epithet *sundra*, which was published for the first time *thirteen years later* by Roxburgh As such, Willdenow could not have made a mistake and used *chundra* for *sundra* There is also no doubt from the above facts, that Willdenow used the epithet *chundra* deliberately, since he has repeated the epithet three times at the same place * It is therefore impossible to prove that in using *chundra*, Willdenow made a "clearly unintentional orthographic error"

The epithet *chundra* was derived from some Indian vernacular name and it is very likely that a foreigner like Rottler had accepted the name as he gathered it from conversation from some Indian associates † It is also likely that it may have been phonetically correct to Rottler, but philologically inaccurate But if we elect to change such names derived from Indian vernacular at a later date, only because these names are inappropriate to an Indian (or Sanskrit) scholar, we submit ourselves to the following difficulties

There are numerous generic and specific names derived from Indian, Chinese, African, or Brazilian names Many of them are not philologically correct to Indian or Chinese or African scholars If all of them substitute new names for these plants at a later date, we will get hundreds of new names and there will be great confusion This has to be avoided under the provision of Art 4 of the rules In fact, a similar practice was used by some authors in the past without success For example, in *Prod Strip Allert* 326 (1796) Salisbury gave a new name, *Moringa erecta* to our familiar *Moringa pterygosperma*, because he thought the former name to be

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* An example of a deliberate use of a form of generic name which resulted in its subsequent adoption could be given by the name *Annona* The more popular and widely used form *Anona* has been now abandoned after many years of use, as it was pointed out that Linnaeus used the form *Annona* deliberately, and not by any mistake In this connection Sprague says (*Kew Bull*, 1928 344), "Linne's action in rejecting the euphonious and historic name *Anona* for the inept one *Annona* may be regretted, but it cannot be reversed under International Rules, except by conserving the spelling *Anona*"

† It may also be possible that he got the name *verbally* from Roxburgh, and as the epithet referred to an Indian vernacular name, Rottler accepted it as all right

more appropriate This did not help future botanists to accept Salisbury's name

It is for this reason, and to safeguard such difficulties, that there is provision in the rules to correct orthographic errors *only* in cases when the names are derived from Latin or Greek

Finally, it may be interesting to see what spelling was used by Willdenow on Rottler's original collection It is only reasonable to expect that the epithet published both by Rottler and by Willdenow is to be found to Rottler's sheet I have been able to examine an old fragment of a sheet which I suspect to be that of Rottler's (see *Kew Bull* 1894 201) In this, the original name is *Acacia chundra,* but the epithet has been changed by a subsequent hand to *sundra* Although this finding is not very conclusive, it may not be impossible to confirm this from some other European herbaria where Rottler's duplicates may be found

It is unfortunate that the name *Acacia chundra* could not be changed either on ground of orthography, or because it is inappropriate It has to be accepted as the legitimate name

In this connection the following note from the Rules of Nomenclature could be quoted with advantage (Art 70 note 2 *bis* in *Brittonia 6* 26, 1947) —"The liberty of correcting a name must be used with reserve especially if the change affects the first syllable and above all the first letter of the name"

D CHATTERJEE

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Kew, 8 8-1948

[1] Bor and Chatterjee, SCIENCE AND CULTURE, *13* 274 1948

EMISSION BANDS OF TOLUENE

FOLLOWING our communication on the emission bands of benzene,[1] we have been able to excite the emission bands of toluene in the near ultraviolet The bands can be excited either by high frequency discharge or suitable transformer discharge in flowing toluene vapour The spectrum obtained by the second type of discharge gives a more intense development of the bands Stewart and collaborators[2] have excited the bands in the Tesla discharge but their data are few and accuracy low The spectrum consists of a continuous emission in the body of which the discrete emission bands are situated The continuous spectrum seems to have a sharp short wavelength limit which on analysis is found to coincide with the origin of the discrete band system About thirty-four discrete bands have been measured most of which are counterparts of the correcting absorption bands already recorded in literature A complete analysis of the bands has been made (see Table I) which is naturally in line with the analysis of the absorption bands The continuous emission spectrum is about as intense as the discrete bands and seems to have an uniform intensity from the beginning of the band at about 2667Å upto about 3500Å after which the intensity gradually begins to decrease It is suggested that this continuous emission spectrum is due to the excitation of phenyl radical A detailed communication on the subject which is still under investigation will be published elsewhere

TABLE I
EMISSION BANDS OF TOLUENE

ν vac cm^{-1}	Int	Assignment
37475	5	0, 0
37452	1	+1189 − 1212
37416	1 5	−59
37379	1	+528 − 620
37354	0	−2×59
37320	1	+456 − 620
37299	2 5	178
37244	2	2 − 59 − 178
37199	1 5	− 2×620 + 964 932 − 1212
37130	0	−340, 2×178 (?)
36960	2	−514
36888	5	
36851	2 5	−620
36785	2	−514 − 178
36688	4	−785
36657	0	+751 − 2×786 − 2×1003 + 1189
36625	5	785 − 59, −842
36529	0	
36514	0	785 178
36494	0	−985
36467	2	−1003
36430	0	−985 − 59
36415	0	−1003 − 59
36403	0	−1070
36307	1	−1176
36293	0	1003 178
36281	0	
36263	f	−1212
36205	0	1212 − 59
35842	5	−1012 − 620
35733	0	
35681	1	−620 − 1176
35469	0	−2×1003
35421	0	
35296	0	−1003 − 1176
35068	0	−2×620 1176
34842	0	−2×1003 620
34680	1	−2×1003 − 785
34265	0	
34202	0	

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6-9-1948

[1] Asundi and Padhye, *Nature* *156*, 368, 1945
[2] Stewart, Recent Advances in Physical and Inorganic Chemistry, p 350, 1930

RECLAIMING THE INDIAN DESERT

I

PITHAWALLA has failed to grasp the essentials of the economic aspect that I tried to bring to the fore and moreover he has also completely misunderstood some of my statements which are of importance to the discussion [1]

I explicitly stated that there were already six "large bunds" on the Luni River and its tributaries of which only one filled with anything like reasonable frequency, yet in his reply Dr Pithawalla questions whether I may not have meant weirs, had they been weirs the picture would have been still more unfavourable!

The point which I had hoped to make clear was that as the existing reservoirs filled rarely there was no point in "putting two buckets where one did not fill"

The Pichiak irrigation reservoir, located on the Luni River some 40 miles east of Jodhpur City, has filled only once in the past 18 years and, as an irrigation reservoir, it is an economic failure, but as it was built as a famine relief work it cannot be looked upon solely from the strictly economic point of view

However an Engineer, charged with the expenditure of public funds, cannot allow himself to be entirely swayed by idealism, either his own or that of others, if he did he would very soon be checked by that part of the Administration responsible for finding the money, it is difficult enough to obtain the necessary funds for projects which can be proved to be economical, as every Engineer knows, in India or elsewhere, and he is under a constant fire of criticism from some party or other until a project has finally proved to be profit yielding

Dr Pithawalla is certainly incorrect in stating that the average annual rainfall of the Luni basin is 18 95 inches, the figure given in my letter is correct, it has been taken from data provided by the Meteorological Department of the Government of India

The 15″ isohyet passes through the basin dividing it into two parts, of which 9728 square miles lie to the west and 6297 miles to the east, the 20″ isohyet passes along and close to the eastern boundary of the basin

I gather from para 2 of Dr Pithawalla's reply that he proposes low weirs or bunds across the stream beds as a means of controlling and preventing loss of water to the Runn of Cutch, even if there were sufficient water to fill more "buckets" with economic frequency than the number already existing, these weirs or low bunds would be filled with sand within a very few years and all that would be achieved would be a raising of the river bed over a short distance with the consequent encouragement to the river to meander and cover good agricultural land with sand, and this widening of the river bed is certainly not the happy circumstance that Dr Pithawalla believes it to be, as the covering of sand would ruin the land from the point of view of cultivation

We have examples of this in places where our rivers have left their beds due to sand choking

The frequency of floods referred to by Dr Pithawalla in para 3 of his letter does not in fact occur and expensive protective works are definitely not justified, what is required, and is being done, is to plant a quickly growing scrub along the banks of the rivers to prevent as far as possible the drifting of sand into the river beds, and so choking them that even a small flood is forced outside the beds carrying a load of sand, which, as pointed out above, destroys adjacent fields

The reference to tube wells along the Luni is unfortunate as Jodhpur Government engaged a Commission of experts in 1938 to settle this vexed question once and for all The Commission comprised Sir W Stampe, Dr Heron and Dr Mackenzie Taylor and others and as a result of their investigations they gave it as their definite opinion that conditions for tube wells did not exist in this State, so far as the Luni River is concerned this was in any case definitely established by the results obtained by the Jodhpur Railways pumping plants interspersed along the river and by an investigation of cultivators, wells as far downstream as Chitalwana

Some of Dr Pithawalla's conceptions are so at variance with what actually exists that I cannot but advise him to visit the country and spend some time here before writing in such optimistic vein as to what he thinks is possible, I do not wish to decry his very laudable desire to see something done to improve this country because a lot can, and should be done, but I do not think he should intrude quite so much into the sphere of the Engineer, at any rate without in the first place paying a visit and seeing the country if possible in company with the Engineer in charge, particularly as in my own case I have spent 18 years in the State during which period I have made an intensive study of the topography, geology and hydrology in an effort to improve conditions for the cultivator, during this time there have been numerous discussions with outside experts designed to check my own conclusions and to bring other experience to bear upon the problems to be solved

F F FERGUSSON

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14-9-1948

[1] SCIENCE AND CULTURE, *14*, 116-118, 1948

II

On the subject of the Luni Basin Mr Fergusson has made some remarks which need a rejoinder.

The Economic Aspect.—He has constantly stressed upon the *economic aspect* of the scheme presented by me for saving and conserving every drop of good water in the Indian desert at any cost. I wish he had, as an expert, dealt with the *engineering side* of the whole problem and showed us how such a conservation of the water resources can be achieved.

Economic aspects we must look to. But in the campaign of Grow More Food, have the Government of India not forced the *zamindars* and cultivators to cultivate *food* crops in areas which can only raise *cotton* crops conveniently, as there is cotton (black *regur*) soil available? Where more food grains are badly required, are not even the waste lands to be reclaimed and are not all the water resources to be conserved at any cost? So even if the frequency of floods is so poor, engineering works have to be constructed wherever possible even if it is for getting over a famine year. Besides, we have to rehabilitate millions of refugees in our country, most of whom are farmers by profession.

Rainfall Data.—The rainfall data utilised by me for my paper have been taken from the Annual Report of the Central Irrigation and Hydro dynamic Research Station, published by Sir C. Inglis at Poona in 1945. The desert rainfall is always erratic and variable and nothing can be said with certainty about them; there is however, an appreciable increase of rainfall in the Indian desert and we must take the *fullest advantage* of the circumstance.

Silting and Sand-choking.—This is a technical matter in which Mr Fergusson is an expert and I have nothing to say. Mine are only the suggestions for conserving the water resources, both on the surface and underground and too much cannot be written about it. To avoid such a severe silting up of our water channels, Mr T. A. W. Roy of the Punjab Service of Engineers has made a suggestion that *more and more canalisation* will help in reducing the amount of silt deposits in the channels.

As regards sand-choking, Mr Fergusson himself has recommended planting of quickly growing scrub along the banks of the rivers, which would no doubt prevent the sand drift into the river beds. Thus both silting and sand-choking can also be avoided to a great extent while saving precious water, usually running to waste into the sea.

Tube-wells in the Luni basin.—Mr Fergusson has made a general statement that tube-wells are not possible in the basin and no definite localities are pointed out nor are any reasons given. If it is a case of salinity, it has been noticed in other parts of the country that it is generally reduced in *the sands and gravels of river beds* from which salts are washed off after floods. Karachi gets millions of gallons of potable water from the Malir basin, which is surrounded by limestone rocks containing connate salt. For tube-wells I have suggested only a restricted part of the Jodhpur State, *viz.*, the Luni-Jawai Doab. Any data from this area would be worth studying.

Lastly, it is a matter of great regret for me to learn from Mr Fergusson that a geographer has no business to intrude upon the sphere of the engineer! Such a sad and sorry attitude has been the cause of ruination in our country. Geography is, however, proved to be a powerful synthetic science and has now come to stay. Other advanced countries have been employing expert geographers not only for surveying the different regions of the earth and their economic resources but also for national planning. Without them all projects would be imperfect and unprofitable. This is an age of co operation and co-operative efforts for *all* scientists, for the future welfare of the Indian sub-continent and I suggest that such an opportunity in our country should not be lost.

As for Mr Fergusson's invitation to me to visit the State it is not known whether it would be as a State guest or at my own expense, which unfortunately I can never afford, so poor is the purse usually of a teacher like me.

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[This correspondence is closed. Ed. *Sci. & Cul.*]

PERIODIC FADING OF RADIO SIGNALS AND VERTICAL MOVEMENT OF IONOSPHERIC LAYERS

FROM our observations on fading patterns of shortwave radio signals[1, 2, 3] it has been found that periodic type of fading may occur under two distinctly different conditions. In the first condition, it may be either caused by interference of two waves reflected from the same ionospheric layer due to double reflection or from two different layers when one or both the layers possess slow vertical movement. Secondly, it may be due to interference of ordinary and extraordinary components of the wave caused by magneto-ionic splitting.[4] It may be remembered that the former condition, particularly in the case of double reflection, demands higher electronic density in the

ionospheric layer, whereas the density required for the latter condition is comparatively low so as to be just enough for single reflection between the transmitting and receiving stations We have observed both the above types of periodic fading and a few typical records of them obtained on 19m band for transmission from Delhi have been shown in the diagrams given below

Fig 1 shows the periodic pattern of fading of the first type due to double reflection from F_2-region when the electronic density was fairly high It may be observed that under such conditions if there is no movement of the ionospheric layer, the fading pattern will be of slow random type as will be seen in the

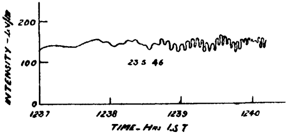

FIG 1

first portion of the diagram As the layer begins to move up or down, quick periodic variations of intensity are superimposed on the initial slow random type of fading as shown in the latter portion of Fig 1 It may be mentioned that the reflections from F_2-region were confirmed by measurement of the angles of downcoming waves The record of second type of periodic fading due to magneto-ionic splitting is shown in Fig 2, when the electronic

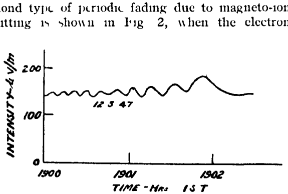

FIG 2

density was low and gradually decreasing, which is evidenced by the disappearance of the signal due to want of adequate amount of electrons in the layer as will be seen at the end of the fading pattern It should be observed in Fig 2, that the intensity of signal increased before its disappearance as is expected in case of thick ionospheric layer It may be added that if the electronic density in the ionosphere happens to be very near the value required for double reflection, then also, a slow periodic fading pattern will result due to magneto-ionic splitting of the doubly reflected wave, but this pattern will have, in addition, slow random or quick periodic variation superimposed on it due to the presence of the singly reflected wave The superimposition will be *slow random* when there is no vertical movement of the layer and *periodic* when there is movement A typical fading pattern of this type is shown in Fig 3, when there was a vertical movement of the F_2-layer

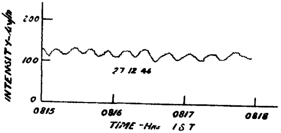

FIG 3

The vertical movement of the layer in all the above cases were ascertained from the rate of its movement calculated from the fading pattern and compared with the variation of height of the F_2 region as recorded by the Research Department A I R , Delhi The conditions for formation of the above types of periodic fading were verified from the knowledge of electronic densities existing in the F_2-region at the time of observation Considering thick ionospheric layer for the observations in Fig 1, the calculated electronic density required for double reflection was found to lie between 1 6 and $1 9\times 10^6$ electron/c c according to the thickness of the layer, and the existing electronic density at the time of observation was 1 86 × 106 electron/c c Further, the rate of movement of the layer calculated from the fading pattern is 10 3 km/hr which agrees fairly well with the observed rate of decrease in the height of F_2-layer which was 12 5 km /hr

That the periodic variation of intensity shown in Fig 2, was due to magneto-ionic splitting will be seen from the existing electronic density in the F_2-region which was about $1 3\times 10^6$ electrons/c c at the time of observation, whereas the required density for single reflection from F_2-layer is about $1 2\times 10^6$ electrons/c c The signal disappeared as the electronic density went below $1 0\times 10^6$ electrons/c c Fig 3 shows the superimposition of quick periodic ripples on the above type of smooth periodic fading brought about by the vertical movement of the layer During this observation the electronic density was $1 6\times 10^6$ electrons/c c which is the lowest amount required for double

reflection as mentioned previously The rate of the vertical movement of the layer as calculated from the fading pattern is 15 6 km /hr and the observed average decrease in the height of F_2-layer was about 13 km /hr

In view of the importance of such periodic fading patterns in practical radio-communication, it may be mentioned that the first type of periodic fading usually indicates higher concentration of electrons in the ionosphere and consequently predicts fairly satisfactory condition for reception The second type, on the other hand, which is caused by magneto-ionic splitting, generally occurs towards the evening, when the electronic density tends to decrease, and thus, indicates the possibility of deterioration in signal intensity It may be further noted that from such observations of periodic fading patterns, it may be possible to detect fairly slow vertical movement of the ionospheric layers as shown above Further details of these observations will be published in the *Indian Journal of Physics*

The authors have great pleasure to record their thanks to Principal M Sengupta and Prof G C Mukherjee for their kind interest in the above investigations Their thanks are also due to the Research Department, All India Radio, Delhi, for supplying the Ionospheric Data One of us (R N S) is grateful to the Government of United Provinces for granting research scholarship for carrying out the above investigations

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[2] S S Banerjee and G C Mukherjee, *Nature* *158*, 413, 1946
[3] S S Banerjee and G C Mukherjee, *Phil Mag* (*in the press*)
[4] E V Appleton and W J G Beynon, *Proc Phys Soc* *58*, 59, 1947

ON THE ASSAY OF LIVER EXTRACTS

VARIOUS methods of extraction of anti-anaemic principles from liver have been developed While the highly purified fractionated liver extracts have been found to be extremely efficacious in preventing relapses of pernicious anaemia, the same do not render much benefit in other macrocytic anaemias, such as the tropical anaemias In these conditions, extracts of whole liver, as developed by Gansslen[1] or proteolysed liver extracts[2] have been shown to be more effective [3]

Many attempts have been made to develop laboratory methods of assay for liver extracts Some of these methods have been tried in this laboratory Trials were given in rabbits using Krogers antigen[4] from Vi strain of *B Typhosus* Pigeons rendered anaemic by injection of *B Welchii* toxin (*cf* Beard, 1928)[5] were also used Growth studies on guinea-pigs were also attempted But all these attempts failed Counting of reticulocytes in the pigeon is difficult owing to over-lapping of various stages of reticulocytes (*cf* Nittis, 1938) [6] Ultimately, the method of Jacobson,[7, 8] using normal adult guinea-pigs, was tried The present note gives the results of observations obtained from several liver extracts, assayed with this method

More than hundred guineapigs (240-400 gms) were used in this study At the outset, groups of animals were kept in uniform diet and the fluctuation in daily reticulocyte count was recorded, in order to determine the mean reticulocyte percentage of a normal population The following figures were obtained

Mean reticulocyte count	0 65%
Probable error, according to Peter's formula	0 25
P E ×3 2	=0 8

Several preparations of liver extract, prepared by different methods in the laboratory were then subjected to bio-assay, by this method For comparison, "Neo-Hepatex" was taken as the standard, as this preparation always gave uniform reticulocyte response in fairly low dosage in our animals As negative controls, saline (0 9 per cent) and casein hydrolysate containing equivalent nitrogen per c c were taken

From the results of the assays, it was observed that liver extracts prepared by vacuum concentration are more potent than those obtained by open concentration Proteolysed liver obtained by auto-enzymic hydrolysis, however, showed a fairly high reticulocyte response when compared with other liver extracts, in terms of mgs of raw liver dose for dose

It was, therefore, surmised from these studies that Jacobson's method could certainly be taken advantage of in determining the relative potencies of a similarly prepared group of liver extracts The method serves as a qualitative method or at best, a relatively quantitative one It was also observed that our guineapigs required for minimum effective dose a far larger quantity of liver than reported by Jacobson (*loc cit.*)

Details of the paper will be published elsewhere

A N Bose

Bengal Immunity Research Institute,
Calcutta, 16 10-1948

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Jacobson B N *J Clin Invest* *14* 665 1935
[7] *Idem Ibid* 679

GALLIUM IN INDIAN ALUMINIUM

In the previous investigations of the authors[1,2] gallium content in nine different samples of Indian bauxite has been determined by the carbon arc cathode layer method of spectrographic analysis and by colorimetric method (chemical) Because of the similarity of the ionic radii of Al and Ga, both exists simultaneously So a fair concentration of gallium is expected in aluminium metal prepared from bauxite

The gallium content of aluminium from Messrs Aluminium Corporation of India has been determined by both the methods Al-metal dissolved in HCl, precipitated with ammonium chloride and ammonia, and ignited to constant weight 3 mg of this powdered mixture is utilised and the spectrum obtained maintaining the same operating technique, the shape of the cathode, exposure, development and all other variable factors as before [1] The gallium concentration is determined by visual comparison with standard plates

In the colorimetric method, 0 5 g of finely divided aluminium is dissolved in strong HCl The acidity is adjusted to 6N in HCl and gallium is removed by repeated extraction with ice cold ether Ether was removed from the combined ethereal extracts The gallium together with iron (present as an impurity in the metal) is treated with 1N NaOH, filtered and washed with 5N NaOH till the residue is free from gallium (tested spectrographically) Traces of colloidal iron from the filtrate is removed with MnO_2 as collector From this filtrate gallium is again extracted as described above Gallium thus obtained is pure and estimated colorimetrically with quinalizarine as before [2]

TABLE

Source of bauxite utilised for Al-metal	Colorimetric method		Spectrographic method	
	% of Ga in bauxite	% of Ga in Al metal	% of Ga in bauxite	% of Ga in Al-metal
Salgipat, N Lohardaga, Bihar	0017	007	002	008

It is found that gallium has been four times concentrated in the Al-metal In this connection it may be mentioned that one ton Al-metal is obtained from four tons bauxite

Our best thanks are due to Prof P B Sarkar, for his kind interest in the work and for providing laboratory facilities, to the Director, C S I R, for the research grant, and to Messrs Aluminium Corporation of India, Ltd, for kindly supplying the aluminium metal

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29-11-48

[1] Mukherjee B and Sarkar, P B, Science and Culture, *12* 598 1947, Mukherjee, B, *Proc Nat Inst Sc Ind* *14*, 169, 1948
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ALLAHABAD

ANCIENT—MEDIAEVAL—MODERN

ALLAHABAD IN MYTHS AND LEGENDS

CELEBRATED in legend, hymns and history alike, Prayaga or Allahabad where the Indian Science Congress holds its 36th session after an interval of eighteen years, is one of the oldest living cities of India whose origin is hidden behind the mists of mythology. The name Prayaga means a place where great *yagnas* (sacrifices) have been performed. Grandfather Brahma, the Creator-God of Hindu mythology, is said to have performed here the *Aswamedha Yagna* (horse sacrifice) in token of his universal supremacy. That is the reason why Prayaga is often alluded to as the *Tirtharaja* (king of holy places). In the *Manusmriti*, Prayaga is mentioned as lying to the east of "Madhyadesha", the present United Provinces.

The great epic *Ramayana* mentions that while crossing the Jumna on his way to the south, Rama with his consort and brother rested in the shade of the *Akshaya Vata* (the eternal *Ficus religiosa*). It further narrates how they stayed in the *Ashram* of the great sage Bharadwaja and bathed at the confluence and how Bharata came here to seek his elder brother. Even in those olden times Allahabad is said to have been a great seat of learning—probably even greater than our modern University. Kulapati Bharadwaja is said to have pupils numbering about 10,000 to whom he also offered free lodge and boarding.

Allahabad district is full of antiquarian remains. Antiquarian scholars have identified the place mentioned as Varanabata in the *Mahabharata* as the country around Allahabad and the extensive ruins near the village Kosam, 30 miles up the river Jumna, which have not yet been turned by the archaeologists' spade, as the ancient city of Kausambi. Kausambi is found mentioned not only in the Vedic scriptures like *Satapatha Brahmana* as a noted centre of learning but also in the *Matsya Purana* where it is spoken of as the capital of the Pandavas after their original capital Hastinapura in the Meerut district was washed away by the Ganges. In Patanjali's "Mahavasya" and Pali Texts, Kausambi is said to have been as important as Varanashi in the trade route between the eastern part of India (Pataliputra) and the West (Saketa). In course of his wanderings, Lord Buddha spent the 6th and 9th years of his ministration in this place and before his death (ca. 543 B.C.) succeeded in converting its king Udayana famed in love and romance to his faith. Asoka, the greatest king in history, whose *Dharmachakra*—emblem crowned by four couchant lions—our National Government has adopted, made Kausambi one of his provincial capitals.

The great poet Kalidasa has alluded to Kausambi in *Meghduta* and has mentioned Prayaga in *Raghuvansa* where he has beautifully described the confluence in his inimitable style. Fa Hien, the Chinese traveller who visited India late in the 4th century A.D. probably during the reign of Chandragupta Vikramaditya (375-414 A.D.) was also struck by the grandeur of Allahabad and Kausambi which were stated to be in a very flourishing state.

Early in the seventh century after Christ, Allahabad belonged to the dominions of Harshbardhana, the great Emperor of Northern India in whose time the famous Chinese monk, Hieuen Tsang visited India. The Chinese traveller has given us a vivid description of the way in which the generous kings, during a quinquennial fair held at the confluence, gave away all the accumulated wealth of five years including his personal belongings to the religious orders, Hindu and Bauddha, the poor and the needy and at the end borrowed a loin cloth from his sister returning to his kingdom. Even now at the very spot and at the same time of the year a fair called *Magh Mela* is held annually which is visited by pilgrims numbering in millions. Every twelve years the fair is known as the *Kumbha* which is regarded as very auspicious. The origin of the word *Kumbha* is to be found in the legend in which Garuda while carrying the pot containing Nectar that arose during churning of the ocean is supposed to have rested here during his flight to the heavens. The sangam (confluence) is also called "Tribeni" (*i.e.*, junction of three rivers) by pious Hindus since according to the old and widespread belief there was a third river, the Saraswati, joining the Ganges and the Jumna at their meeting place. This river which now disappears in the sands of Rajputana is said to have flown according to Hindu credulity underground on its way to the sangam (confluence).

The sangam in olden days was situated by the side of the abode of the sage Bharadwaja and probably parts of the present city of Allahabad like the Tagoretown and Georgetown were situated under it. This is to some extent testified by the fact that during

construction of buildings in these areas the subsoil is formed to consist mainly of sand The construction of the Fort and the embankment (Bund) has shifted the position of the sangam to a more distant place

Archaeological remains round Allahabad

Apart from the mythological accounts, the archaeological sites and remains in and around Allahabad also throws light on its ancient culture On the other side of the Ganges opposite the Fort is situated

Asoka Pillar inside the Fort

the mound of Jhusi which has been identified as the Partisthanpuri of the ancient times This place was the capital of the kings claiming descent from the Moon and is said to have been founded by Ila* son of Prajapati The mound is surrounded by the remains of a fort presumably built by the great Gupta conqueror Samudra Gupta (330-375 A D) and contains a huge well known as *Samudra Kupa* The remains of bricks of the early Buddhist shape and size testifies to the existence of a Buddhist *vihara* which has also been mentioned by the Chinese travellers Copper plates containing inscription of the last members of the Imperial Pratihar dynasty which ruled Northern India from 834 A D —1018 A D from their seat in Kanauj and were overthrown as a result of the raids of Sultan Mahmud of Ghazni have been recovered here

The Asoka Pillar standing within the compounds of the Fort, is a single shaft of polished sandstone 35 feet in length with a diameter of 2 feet 11 inches near the base whose circular abacus with lotus and honeysuckle still remains but unfortunately the capital is missing The pillar contains a famous inscription of Asoka although most of the third and fourth edicts has been destroyed by Jehangir who has recorded therein the names of his ancestors Immediately below the Asoka edict are found the inscriptions of Samudra Gupta, describing his conquest of the kings of Northern, Eastern and South India According to one view the pillar was brought from Jhusi but as the Asoka's edicts are also addressed to the *Mahamatras* of Kausumbi it is usually held that the pillar originally belonged to Kausumbi and was removed to the Fort by Akbar or Feroz Shah where it was re-erected by Jehangir in 1605 A D In Kausambi, there stands another similar pillar which does not contain any Asokan edict

The subterranean "Patalpuri" temple inside the Fort is doubtless of some antiquity as can be gauged from the conditions of the idols as well as its reference in the mythological literature and accounts of travellers like Hieuen Tsang The banyan tree "Akshaya Vata" which is reputed to have been in this place from time immemorial, is now represented by a forked trunk inside the temple which the priests maintain to be still retaining its vitality Padre Tieffenthaler as long ago as the middle of the 18th century described the tree as leafless but in one of his visits the writer observed pale leaves on a branch arising from the trunk The secret of the undying "Akshaya Vata" is well kept by the priests and no one has yet been able to verify the suggestion that when the trunk rots away it is replaced by an exactly similar one

Among the places of antiquity around Allahabad mention has already been made of Kausambi Delegates to the Science Congress will find a visit to the Allahabad Municipal Museum where some of the archaeological finds and the antiquities are housed These are extremely interesting Another place called Singraur, 22 miles to the north west on the banks of Jumna is held to be the place where the king of Bhils welcomed Rama on his way to the

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* Ila was perhaps both a son and a daughter as will be apparent from history given in *Ramayana (Uttarakanda* Chapters) He was periodically changed into a woman and was then known as Ila It was during this womanhood that he conceived a son by Buddha who was named Pururaba Ashamed of his performance Ila abdicated the throne of *Bahlik* (N W F Province) in favour of his eldest son and founded a city in U P and was succeeded by his son Pururaba

south It is also identified with the Ashram of Sringi Rishi and some ruins have also been discovered The rocky islet of Sujaon some miles up the Jumna belonged to the ancient but ruined city of Bhita from which a number of archaeological remains dating from Mauryan times have been found Most of the former city has been engulfed by the change in the course of the river and the rock, which is 60 feet high, stands in solitary grandeur in the midst of the stream It had on its top a Hindu temple which was destroyed by Shaista Khan in the reign of Shah Jehan and a cupola erected in its place "Sujaon" itself is identified by Pt K C Chattopadhaya as 'Shujamuna', the palace on the Jumna, mentioned in old literature The name reminds one of the 'Shuganga' palace of the Mauryas at Pataliputra, mentioned in Kharvela's inscription

Garhwa, situated a few miles to the north of Allahabad, has numerous archaeological remains including a fort and a large masonry tank Apart from Buddhistic remains there are also ornamental pillars of different types of architecture as well as images of Vishnu, Mahadeva, Brahma and Krishna Although many of the images are of more recent origin yet significantly the noses of almost all the figures are wanting and appears to have been broken off According to General Cunningham these are good examples of Indian sculpture of the 12th century

ALLAHABAD DURING MUSLIM RULE

From the year 1090 A D for about a century Allahabad was included in the Kingdom of the Gahadvals of Kanauj but in 1194 A D after the defeat of Emperor Jai Chand at the hands of Sahabuddin Ghori this city passed under the rule of the Mahomedans After about four centuries of comparative obscurity Allahabad again attained prominence during the reign of Akbar who after the battle of Fatehpur* in 1567 A D came and rested at Prayag for two days The present fort at the confluence of the Jumna and the Ganges was built by him and was completed in the 21st year of his reign Akbar founded a mint at the Fort and also created the Subah of Allahabad comprising Gazipur, Benares, Manickpur, etc Maharaja Bhagwandas of Amber who accompanied the Emperor during his visit to Allahabad obtained a grant of that piece of land on which the greater part of Katra as well as the Muir Central College now stands

From 1595 A D till his accession to the throne in 1605 A D Prince Selim afterwards Emperor Jehangir was Governor of Allahabad After the rebellion and death of his son Khusru the latter's body was buried in a tomb in Khusrubagh The prince's tomb is the easternmost of the row of three, middle of which is the tomb of Khusru's sister, and the one to

Tombs at Khusrubagh

the west is ascribed to Khusru's mother and wife of Emperor Jehangir, who hailed from the Hindu Royal House of Jodhpur Apart from these stands a building ascribed to one Tamboli Begum The whole areas of Khusrubagh is surrounded by a lofty wall of sandstone pierced by two impressive gateways in the south and in the north The former is about 60 ft high and faces the Grand Trunk Road It is built on the same plan as the gateway of the Tajmahal The gardens are now decorated with flower and fruit trees

During the reign of Shah Jehan and Aurangzeb (1627-1707 A D) the importance of Allahabad declined In 1666, the Mahratta hero Sivaji stopped at Allahabad in course of his flight from Agra and left his son in charge of a Brahmin in Daraganj, while he continued his flight to his homeland

With the decline of the Moghal Power after the death of Aurangzeb, the Mahrattas began their depredations in this area and in 1739 the Bhonsla Chief of Nagpur reached Allahabad, sacked the city and returned to his capital laden with an immense amount of booty He also ordered that the revenue of the Subah of Allahabad should be paid to the Peshwa Balaji Baji Rao The Mahrattas were later (1747 A D) repulsed by the Nawab of Oudh, but during the year 1750-51 the Pathan Chief of Furrukabad, Ahmad Khan Bangash again sacked the city and laid siege to the Fort at Allahabad Allahabad was finally seized by the Nawab of Oudh in the year of the battle of Plassey but he soon came into conflict with the East India Company After a series of battles with the English, the Nawab fell back on Allahabad about the year 1764 Soon a treaty was concluded between them by which the district of Allahabad

* Fatehpur is not to be confused with Fathpur Sikri In May 1567 Akbar left Agra to deal with the rebellious Khan Jaman In the battle at a village 10 miles south west of Allahabad, Khan Jaman was killed and Akbar bestowed the name Fatehpur on the village Akbar then reached Prayag and after two days marched to Benares

was separated from the kingdom of Oudh and made over to the titular Emperor Shah Alam who for a time resided in the Khusrubagh but handed over the Fort to the British A few years later the Emperor joined the Mahrattas and ceded the territory of Allahabad to them At this the British confiscated this territory and in 1773 sold it to the Nawab of Oudh for 50 lakhs of rupees! In 1801, however the district of Allahabad finally passed into the hands of the British "in liquidation of the debt on account of the troops maintained by the East India Company"! It is from here that expeditions were sent to annex Bundelkhand and other neighbouring places During the Government of the East India Company administrative needs led to the establishment of a Board of Revenue and Civil and Criminal courts in 1831 but soon the capital of the newly formed North Western Province was removed to Agra During this period Allahabad experienced famine conditions in the years 1803-4, 1837-38 and also later in 1860-61

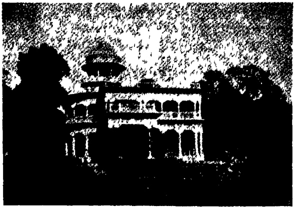
Allahabad under British Rule

Allahabad also took part in the first struggle for liberation of the country from British rule miscalled the Indian Mutiny On 6th June 1857, the sixth native Infantry rebelled, looted the treasury, released the prisoners and murdered a number of Britishers The prisoners along with the rebellious local population was led by Maulvi Liakat Ali who took up his residence at Khusrubagh and issued a proclamation owing allegiance to the so-called Emperor of Delhi On 11th June, however, Colonel Neill arrived at Allahabad with the Madras Fusiliers and the next day Daraganj was taken from the rebels Jhusi and Kydganj fell on the 13th and by the 18th the Kotwali, the Civil Station and the villages around Allahabad were recovered In this struggle Babu Peary Mohan Banerjee who resided near the old Kayastha Pathshala, earned the nickname of the 'Fighting Munsif' as he laid down the pen for the sword and marched at the head of a band of followers, loyal to the British From their secure base at Allahabad, the British organised expeditions all over Northern India to fight the rebels The newly started steam boats plying in the Ganges brought continuous supplies of men and materials from Calcutta, and this was a great factor in defeating the mutiny

Lord Canning arrived at Allahabad in 1858 and not only transferred the capital of the North West Provinces from Agra to Allahabad but it was from here that he first announced in a great durbar held near the Fort, the proclamation of Queen Victoria This spot, now known as the Minto Park, has been commemorated by the erection of a marble pillar topped by the Asokan pillar head of *Dharmachakra* with four lions facing four cardinal directions, in which this fact as well as extracts from the proclamation are engraved

Citizens of Allahabad in the Struggle for Independence

The history of Allahabad after the mutiny is uneventful except for the important part it has played in the national struggle for independence This city has been the birth place or the field of activity of such great congressmen as Pandit Ajudhianath, Pandit Madan Mohan Malaviya, Pandit Motilal Nehru, his son our present Prime Minister, Babu Purushottam Das Tandon along with many other stalwarts in other fields such as Sir Tej Bahadur Sapru Sir Ganganatha Jha and Sir C Y Chintamani The Indian National Congress thrice held its session here and for a considerable time this city has been the 'Capital' of struggling India since the A I C C "Secretariat" has been located in the "Swaraj Bhawan" for more than fifteen years before



Anand Bhawan—Residence of our Prime Minister

its present removal to Delhi The great-hearted Pandit Motilal Nehru in 1931 orally dedicated his palatial residence (Anand Bhawan) to the service of the nation and soon after his death his illustrious son executed this gift In 1942, during the notorious Hallett regime, the building was taken possession of by the Government and kept in such a neglected condition that not only many of the rare books and valuable national records were eaten by white ants but damages that it suffered are now estimated to cost about 2 lakhs of rupees for repairs The building is now proposed to be utilized as an All-India Children's Home

Public Institutions of Allahabad

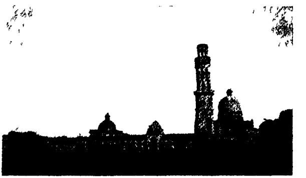
The present importance of the city of Allahabad is barely a century old Along with the transfer of capital, the High Court of Judicature which came

into being, by amalgamation of the Suder Dewany and Suder Nizamat Adalats in 1866, finally shifted to Allahabad in 1869 and with it came numerous Government offices There was then a very rapid growth of the city leading to the establishment of the Civil Lines with its broad straight parallel roads lined with trees and rows of pleasant bungalows In 1877 the administration of Oudh was amalgamated with that of the North Western Provinces and the name was changed to that of the United Provinces in 1902 when this city received a visit from the then Viceroy, Lord Curzon During the Governorship of Sir Harcourt Butler, who liked Lucknow so much that he was nicknamed the last Nawab of Oudh, the Legislative Council Chamber was erected at Lucknow through his initiative, and without the knowledge of the public and since then a landslide movement of Government offices to Lucknow started culminating in the transfer of the entire Secretariat to that city Recently, however, the High Court at Allahabad and the Oudh Chief Court at Lucknow have been amalgamated and located in this city Many important Government offices that still remain are the Accountant General's Office, The Public Service Commission, The Meteorological Observatory, The Director of Public Instruction and the Board of the High School and Intermediate Education Allahabad is still the capital of U P on paper, though Lucknow is the *de facto* capital

High Court

The Allahabad University

Apart from its religious importance Allahabad, is chiefly a city of institutions Amongst the educational institutions, the University of Allahabad is the most important The University originated with the establishment of the Allahabad College in 1872 in the building now known as the Darbhanga Castle The College was renamed Muir Central College in 1886 after the then Lt Governor of the Province, when it was shifted to its permanent buildings which cost about 9 lacs of rupees raised entirely by public subscriptions and took 12 years to build The beautiful stone-faced college building is in the form of a quadrangle with a high tower overlooking it The College had all these years been affiliated to the Calcutta University but with the passing of Act XVIII of 1887 the University of Allahabad was established In the beginning it started as an examining body teaching only Law The passing of the Indian University Act, 1904 (VIII of 1904) empowered the University to appoint Professors and Lecturers to impart teaching in other subjects too The foundation of the Senate Hall was laid in 1910 and soon this and the adjacent English and Law Departments were built at a cost of over 10 lacs of rupees In 1921 the University was reorganized according to the recommendations of the Sadler Commission due to the initiative of Sir C Y Chintamani, then Education Minister changing it into a teaching and residential one and with the birth of five more Universities *viz*, Benares, Aligarh, Lucknow, Nagpur and Agra, its jurisdiction which extended beyond the United Provinces of Agra and Oudh into the Central Provinces and Berar and the States of Rajputana and Central India, came to be limited to a radius of 10 miles around the Senate Hall



Muir Central College and its tower

The University at present has about 4000 students but although the number of students have increased four-fold (it was only 903 in 1921) since its reorganization, there has been practically little increase in Government grant This has naturally hampered any vigorous growth In addition to various arts and science subjects teaching is also imparted in Military Science and in Agriculture for which the Naini Agricultural Institute founded by the American Presbyterian Mission is affiliated to the degree classes There is also a special graduate course for women

In 1923 a separate Women's Department was established mainly for the undergraduate students offering the Arts subjects while the Post-Graduate

students and those offering the Science subjects received their lessons along with men students Recently there has been a phenomenal rise in the number of women students and a Women's Hostel, opened by Sreejukta Vijaylakshmi Pandit, was erected in 1939 to which a new wing had to be added in 1941 The number of inmates number more than a hundred Many of the men students are lodged in six commodious hostels while the day-scholars are looked after by the Delegacy The University Library was recently extended due to the munificence of the Maharajadhiraja Bahadur of Darbhanga and at present houses 1,19,000 volumes of books and manuscripts The University of Allahabad is rightly proud of its foremost position and scholarly traditions Among its alumni shines the names of such luminaries as Sir Tej Bahadur Sapru, Pandit Madan Mohan Malaviya, Sir Sunder Lal, His Excellency Dr K N Katju, Pandit Govind Ballav Pant and a host of others equally distinguished In 1937, the University celebrated its Golden Jubilee and last year amidst scenes of great enthusiasm, the University celebrated its Diamond Jubilee during which distinguished men from all over the world sent their best wishes It was due to the efforts of the Teachers' Association of the University that the first All-India University Teachers' Federation was formed last year with the Hon'ble Dr Shyama Prasad Mookerjee as its President and the first meeting was held here under its auspices

Other Educational Institutions

Besides this great seat of learning there are a host of other educational institutions Mention may be made of the Kayastha Pathsala founded by the donations of Munshi Kalibirprasad and managed by the Kayasth community and the Ewing Christian College founded by the American Presbyterian Mission both of which used to impart post-graduate training before the reorganization of the University The Training College which has recently developed into an Institute of Pedagogical and Psychological research, is the premier institution in the province awarding diploma in teaching The city also teems with numerous institutions imparting instruction up to the primary and secondary or intermediate standards There are also a number of educational institutions meant for girls The Crosthwaite Girls' College is an old institution which for a number of years accommodated the Women's Department of the University The Prayag Mahila Vidyapitha, established in the year 1922 is an independent institution which prepares candidates for the "Vidya Vinodini", "Vidusi" and "Saraswati" examinations recognized as equivalent to the Matriculation, B A and M A standards The Mahila Silpa Bhawan and the College of Home Science impart professional as well as vocational training to the women

Amongst the numerous libraries in the town the oldest is the Public Library founded in the year 1864 Since 1879 it is housed in the Thornhill Mayne Memorial situated amidst the congenial surroundings

Thornhill Mayne Memorial housing the Public Library in the Alfred Park

of the Alfred Park This beautiful building made of a superior kind of Chunar sandstone has ornamental pillars that came directly from Italy The total number of books is about 60,000 some of which are so valuable that a second copy is not to be found elsewhere in India This will be evident from the following remarks of our eminent historian Sir Jadunath Sarkar—"In some sections such as Parliamentary papers relating to India and rare books and pamphlets relating to India before 1875, it has a more complete collection than any Public Library in India known to me " The Library is also rich in Scientific Periodicals most of which are shelved from the very first year of issue

The Hindi Sahitya Sammelan was established in the year 1910 for the promotion of the study of Hindi literature It is an All-India Association formed with the active support of Pandit Madan Mohan Malaviya, Babu Purushottam Das Tandon and also of Mahatma Gandhi who opened the doors of its Sangrahalaya which is a repository for all books published in Hindi A somewhat similar organization is the Hindusthani Academy sponsored by the U P Government for the spread of both Hindi and Urdu Bharati Bhawan is another Hindi library of importance

The National Academy of Sciences, India

Allahabad is justly proud of being the seat of the oldest Academy of Sciences in India Thanks to the efforts of Professor M N Saha, F R S , who, while he was Professor of Physics in the University of Allahabad (1923-38) put forward a strong plea for an Academy of Sciences in U P in the October 1929 issue of the University magazine There had pre-

viously been in existence societies catering to the needs of particular branches of Science but during the Allahabad session (1930) of the Science Congress the scientists of U P together with other Indian scientists resolved "to unite and form themselves into a corporate body for the sake of cultivation and promotion of science in all its branches" The society thus formed was known as "the Academy of Sciences of the U P of Agra and Oudh" with Professor M N Saha, F R S as its first President It held its first meeting in 1931 but the inaugural meeting could not be held till a year later due to the unavoidable absence of its Patron, the Governor of U P In the inaugural meeting messages of goodwill were received from such eminent scientists as Lord Rutherford, Professor Einstein, Sir Arthur Eddington, Professor Millikan, Sir C V Raman, Sir P C Ray and Sir J C Bose The Academy started to publish a bulletin which was soon renamed as *Proceedings* after the model of the publication of the Royal Society and till now 16 volumes of both section A and B have been published The Academy was later converted into an All-India body and renamed as "The National Academy of Sciences, India" It has about 250 Fellows on the roll

Another scientific society "The Vijnana Parishad" was founded in 1913 to enrich the Hindi language with such potentialities as to make it a vehicle of scientific thought Sir P C Ray and Sir J C Bose were life-members of this Parishad while the past Presidents include such eminent persons as Mahamahopadhyaya Dr Ganganatha Jha, Sir Sunder Lal, Mrs Annie Besant and Sir C Y Chintamani During its thirty-six years of useful service it has not only continued to publish a monthly journal *Vijnan* since 1915 but has also brought out numerous books in Hindi on scientific subjects

Among other centres of culture mention may be made of the Sir Ganganatha Jha Research Institute of Indian Philosophy, The Allahabad Archaeological Society, Allahabad Culture Centre and the Prayag Sangit Samity Established in 1926 the Prayag Sangit Samity is the first institution in U P devoted to popularization of Indian and classical music In its own building the Samity not only maintains an Academy of Music as a teaching institution but also conducts examinations in about fourteen centres in and outside the Province It held the first All India Music Conference in 1927 and even now during its convocation week it holds the same conference every other year alternately with a similar conference held under the auspices of the Music Association of the University of Allahabad

The Municipal Museum

An important repository of art in this city is the Municipal Museum which though founded as late as 1931 through the enthusiasm of Pandit Brijmohan Vyas, has an exceptionally rich collection of sculptures, coins and paintings The collection of sculptures from Bharhut numbering about fifty three is unique and possesses characteristics not noticeable in other fragments of Buddhist art A red sandstone statue of Buddha found among the remains of Kausambi bears a legend which reads "In the 2nd year of the reign of Kanishka (80 A D), Bhikkuni Buddhamitra put up this Bodhisattava at the place sanctified by Buddha's several visits" This is the earliest inscribed image of the reign of the Emperor From the ruins of Bhumra belonging to the Gupta period come complete components of a gate with various architectural slabs of which the door jamb contains a most pleasing and graceful figure of a woman standing on a fish tailed human figure plucking fruits from a tree To the same period belongs the remarkable *Eka Mukha Siva Linga* which according to its discoverer, Mr R D Banerji, late Superintendent of Archaeological Survey of India and discoverer of the Indus Valley civilisation is an epitome of grace and is one of the best specimens of sculpture of the Gupta art

The terracottas of which there are 3000 items from Kausambi, form the largest collection from a single site In addition to amorous scenes, abduction of Princess Vasabadatta by King Udayana which forms the theme of one of Bhasa's famous dramas is also depicted One fragment contains along with two female figures an inscription of two lines in Brahmi characters This is the second inscribed example known—the first being the one kept in the Boston Museum, U S A The coin cabinet is rich in currency of the first and second century B C and contains more than 10,000 coins from Kausambi, alone This has brought to light the names of more than two dozen kings lost to memory The beads from Kausambi are regarded as "highest watermark in the ancient stone-cutter's art"

The section on Paintings contains some masterpieces of Irani, Moghul and Rajasthani school including the Rag Ragini set of Jaipur There are about 300 paintings of the Akbar-Jehangir period as also a portrait of Emperor Aurangazeb The Rajasthani pictures according to the members of the Royal Academy of London who visited the museum in summer of 1947, are the finest and the most representative specimens of the school in this country For the modern paintings no less than four halls have been devoted each to the works of Dr Roerich, Asit Haldar, Anagarika Govinda and Sudhir Khastagir The celebrated Russian painter Dr Nicholas Roerich in 1938 donated twenty of his best group of paintings inspired by the Himalayas which are now valued at 3 lakhs of rupees There are also

specimens from such celebrated artists as Abanindranath Tagore, Jamini Roy and Amrita Sher Gil

One of the most valued possession of the museum is the Nehru collection to which an entire big hall has been devoted This consists of gifts presented to the most illustrious son of Allahabad, Pandit Jawaharlal Nehru during his tours in India and abroad This collection will be adored not only as a glorious tribute to the personality of this great man but also as a symbol of the upsurge of an oppressed nation trying to recover its soul The museum is going to be located amidst more congenial surroundings in the Alfred Park where its foundation stone was laid last year by Pandit Nehru During this ceremony the Prime Minister announced that this museum is going to be one of the best of its kind in India and would house the ancient treasure now stored in London from where they would soon be brought back

Amongst the numerous institutions created for the benefit of the public, mention may be made of the Kamla Nehru Memorial Hospital erected to the memory of the worthy consort of Pandit Jawaharlal Nehru Its foundation stone was laid by Mahatma Gandhi and it has now grown to be one of the biggest hospitals in India for the women The Alfred Park with an area of 133 acres is a beautiful recreation ground The Mayo Hall built in 1879, entirely by public subscription at a cost of nearly two lakhs of rupees, had been used for all public meetings but is not much utilized now owing to lack of sufficient accommodation Employment Exchange offices now adorn its compound In addition to the All Saints' Cathedral, the beautiful Roman Catholic Church was built in 1879 but the Holy Trinity Church on Motilal Nehru Road is the oldest being built long time before the Mutiny

A large number of societies for social and religious services exist in the city, some of the chief ones being the Harijan Ashrama, the Leper Asylum, the Rama Krishna Math, the Bharat Sewashram Sangha, the Seva Samity and the Social Service League of the University This city is also the Headquarters of the Hindusthan Scouts Association

Being an important centre of the printing trade Allahabad has always occupied a prominent place in Journalism The "Pioneer" started publication in 1865 from this city but has now shifted to Lucknow The "Leader", which was for a long time edited by the famous journalist Sir C Y Chintamani, and the Amrita Bazar Patrika are the two English dailies of the city The Indian Press is a very old institution which not only brings out the oldest Hindi monthly "Saraswati" but also has the credit of being the publishers of many of the earliest works of Tagore

The writer* is indebted to Dr A K Mitra and Mr D D Pant of the Botany Department, University of Allahabad, for their help in the preparation of this article

* Prof Shri Ranjan, Professor and Head of the Botany Department and Dean of the Faculty of Science, Allahabad University Prof Ranjan is also one of the Local Secretaries of the present session of the Indian Science Congress

SHORT LIFE SKETCHES
OF THE
General President and Sectional Presidents
Thirty-sixth Session of the Indian Science Congress Association

K S KRISHNAN,

General President

PROFESSOR SIR K S KRISHNAN has had a remarkably brilliant career After completing his university education, Krishnan joined the staff of the Madras Christian College, but his thirst for higher studies and research did not keep him long there In 1923 he joined the band of research students working under the inspiring guidance of Professor C V Raman at the Indian Association for Cultivation of Science, Calcutta Placed in the proper environment, Krishnan soon shone out as an enthusiastic and brilliant investigator In 1928, he was appointed Reader in Physics at the Dacca University This post he occupied with distinction for five years, and when Professor Raman left Calcutta in 1933, Dr Krishnan was appointed to the newly created Mahendralal Sircar Professorship of Physics at the Association Professor Krishnan successfully kept up the great research traditions of the Indian Association acquired during the leadership of Professor Raman In recognition of his distinguished researches in optics, and especially for his study of the influence of magnetism of crystals, he was elected a Fellow of the Royal Society of London in 1940 In 1942, he was invited by the Allahabad University to occupy the Chair of Physics to which post he continued till 1948 when he was appointed as the first Director of the National Physical Laboratory, New Delhi

The research activities of Professor Krishnan and his associates extend over diverse branches of physics During the years 1923-28 he carried out a series of important investigations, both theoretical and experimental, on the scattering of light, molecular optics and Raman effect, in collaboration with Professor Raman While at Dacca, and later at the Indian Association, Professor Krishnan initiated and conducted with conspicuous success numerous investigations on the magnetic properties of crystals, the results of which were published as memoirs in the *Transactions of the Royal Society of London* Outstanding investigations on the optical properties of crystals and X-ray crystallography have also been carried out by Krishnan and his collaborators At Allahabad, Professor Krishnan built up an active school of research carrying out investigations on the thermal and electrical properties of metals and alloys

He first visited Europe when he was invited to take part in the International Conference on Photo-Luminescence held at Warsaw in 1936 In 1937, he toured widely throughout Europe and delivered lectures at the Royal Institution in London and the Cavendish Laboratory in Cambridge and in many other important universities and research centres The Liege University honoured him with the award of the University Medal He visited Europe again in 1939 at the invitation of the International Institute for Intellectual Co operation to attend the International Conference on Magnetism arranged by the Institute of Strasbourg In the summer of 1946, he went to England as a member of the Indian delegation to the Royal Society Commonwealth (Empire) Scientific Conference He took part in the third annual conference of the X-ray analysis group of the Institute of Physics held at London in July 1946 At the request of the Government of India, he visited also Europe and America to survey the modern trends of research in the prominent physical laboratories He visited U K again with other eminent Indian scientists in October 1948 and returned on December 18, 1948 During his three months' tour abroad, Dr Krishnan visited various atomic energy research stations in France, Sweden, Switzerland, and

the U K and made a thorough study of latest development in atomic research While in Paris, he participated in the annual conference of eminent French physicists which was organized by the French Academy of Science Dr Krishnan is a Member of the 'Atomic Energy Commission' set up by the Government of India and earlier he was a member of the Board of Research on Atomic Energy and served in a number of scientific committees sponsored by the Government of India

Besides being a Fellow of the Royal Society of London, Professor Krishnan is a member of many scientific societies in India and abroad He is a Fellow of the National Institute of Sciences of India, a past President of the National Academy of Sciences of India, and of the Physics Section of the twenty-seventh session of the Indian Science Congress held at Madras in 1940 He was knighted in 1946 and the Degree of Doctor of Science, *Honoris Causa*, was conferred on him last year by the Delhi University, both in recognition of his services to the cause of Indian science Simple and unostentatious as he is, Professor Krishnan is a gifted lecturer, noted for his profundity of ideas and clarity of expression

U S NAIR

President, Section of Statistics

UNNI NAIR SIVARAMAN NAIR was born in January 1904 in a small town in North Travancore and had his school and college education at Trivandrum After taking the Master's Degree in

Mathematics he joined the Maharaja's College at Trivandrum as a lecturer in 1925 He taught Mathematics to the Pass and Honours students till 1935 and then joined the Statistics Department of the University College, London, as a research student He took the Doctorate Degree in 1937—his main work being on the "Application of Mellin transform to problems of Distribution"

When he returned to Travancore, the State University was being organised and he was entrusted with the teaching of Mathematics and organisation and guidance of research and teaching in Statistics in the new University He had also to serve the Travancore Government as Statistical Adviser in 1944 A separate Division was formed in the University for Statistics and Dr Nair was appointed Professor and Head of this Division The Division of Statistics worked in two directions, (*i*) teaching and research for post-graduate students and (*ii*) Statistics Bureau working as a service agency for the people and the State The data that comes to the Bureau is being handled by the students under guidance

Dr Nair has had considerable experience in teaching of Mathematics and Statistics and has been on various University and technical bodies in India Dr Nair has a number of research papers to his credit and under his guidance a number of research papers have been contributed by his students He is a Fellow of the National Institute of Sciences of India

R S KRISHNAN

President, Section of Physics

PROFESSOR R S KRISHNAN was one of the first research scholars who joined the newly opened Department of Physics in the Indian Institute of Science, Bangalore, in 1933, under Sir C V Raman There he carried out important investigations on the scattering of light in colloids and liquid mixtures and it is now clearly recognised that the reciprocity relation in light scattering (know as the "Krishnan Effect") formulated and established by him as a result of the long series of investigations in 1933-38 on the scattering of light in diverse media, is of fundamental importance in optics and is of the widest generality In 1938, he was awarded the 1851 Royal Exhibition Scholarship as one of the first Indian recipient of this award, and joined the Cavendish Laboratory at Cambridge to work on artificial radioactivity During his stay at Cambridge, Dr Krishnan was a member of the Trinity College and in the year 1939-41 he was in full charge of the Cavendish Cyclotron and gained first hand experience on the fission of heavy elements Numerous papers have been published by him in the *Proceedings of the Royal Society of London* and the *Cambridge Philosophical Society* on the deuteron induced reactions in heavy elements including Thorium and Uranium and

his work elicited the highest praise from the leading authorities in the field In 1942, he returned to Bangalore and has since been carrying out investigations on Crystal Physics both from X-ray and Spectroscopic standpoints The results obtained by him so far have opened out a completely new and vast field of research in Crystal Physics which point unmistakably to a new understanding of the solid state His outstanding contribution is the successful recording for the first time of the second order Raman Spectra of many crystals like diamond, rock salt, potassium bromide, ammonium halides, etc , which are of the greatest significance in relation to the theory of the vibrations of crystal lattices

Dr Krishnan is a member of many learned societies both in India and abroad He was elected a fellow of the American Physical Society in 1941 being the second Indian to be so honoured In 1943, he was elected a Fellow of the Indian Academy of Sciences He succeeded Sir C V Raman as Professor and Head of the Department of Physics in the Indian Institute of Science in 1948

P B GANGULY

President, Section of Chemistry

DR P B GANGULY was born in 1897 and had his early education at Queen's College, Benares Later he studied at the Muir Central College, Allahabad, and secured a First Class M Sc Degree in Chemistry standing first in the University He was awarded the Victoria Jubilee Memorial Research Scholarship and worked under Professor N R Dhar of Allahabad University In 1923, he joined the Sir William Ramsay Chemical Laboratories and obtained his D Sc Degree from the London University He later went to Germany and worked under Professor Max Bodenstein at the Physikalische Chemisches Institute of the Berlin University

In 1927, Dr Ganguly was appointed a lecturer at the Indian Institute of Science, Bangalore, and a year later he joined the Patna Science College, as Professor of Physical Chemistry Dr Ganguly has been engaged in research on Colloid Chemistry for the last twentysix years and among other topics has done fundamental work on silica gel and the constitution of silicate solutions

Dr Ganguly is a fellow of the National Institute of Sciences of India and is now the Principal, Science College, Patna

He rendered conspicuous services as Local Secretary, of the Indian Science Congress held at Patna last year

C MAHADEVAN

President Section of Geology and Geography

PROFESSOR CALAMUR MAHADEVAN was born on 6th May, 1901 He took his B A (Hons) and M A Degrees from the Presidency College, Madras in 1925 and 1927 respectively

Dr Mahadevan worked under Professor Sir C V Raman, from 1925 31 and got his doctorate from the Madras University in 1932 From 1927-30 he was a Madras University Research Scholar, in 1931 Von Humboldt Foundation Fellow and in 1930-31 Dharbanga Research Fellow He acted as Geologist, Hyderabad Geological Survey from July 1931 to February 1945

Professor Mahadevan is a Fellow, of the National Institute of Sciences of India, Indian Academy of

Sciences, National Academy of Sciences of India, Geological, Mining and Metallurgical Society of India and Palaeobotanical Society of India

He has over 80 Research Papers on X-ray Study of Coals and Associated Products, Radioactivity, Economic Geology, Petrology, Engineering Geology, Water supply, Mineralogy, Palaeobotany and Geopolitics

He is at present Head of the Department and University Professor of Geology, Andhra University, Waltair where he is also the Director of research in Geology He is conducting a scheme of research on the Age of the Earth sponsored by the "Measurement of Geological Time Sub-committee" of the Council of Scientific and Industrial Research, Government of India

M S RANDHAWA

President, Section of Botany

SREE M S RANDHAWA was born on 2nd February, 1909 at Zira in the District of Ferozepore (Punjab) He matriculated from Khalsa High School, Muksar, (District Ferozepore) in 1924 and obtained a first class B Sc (Hons) degree in the Honours School of Botany, in 1929 from Government College, Lahore He also obtained a first class M Sc degree on a thesis on Fresh-water Algae of the Punjab

Sree Randhawa entered I C S in 1932, and was posted at Saharanpur in October, 1934 He made an extensive collection of Algae at Saharanpur, Fyzabad, Almora and Allahabad From 1934 to 1940, he was posted at Allahabad as Additional Collector and District Magistrate, from 1940 to 1941, at Agra as Collector and from 1941 to 1945 as Deputy Commissioner of Rae Barelli Sree Randhawa was appointed as Secretary of the Imperial Council of Agricultural Research in March 1945 and continued in that post till November 1946, when he was appointed as Deputy Commissioner of Delhi during a very critical period He is now posted as Deputy Commissioner at Ambala

Sree Randhawa has published 32 original papers on Fresh-water green Algae of North India in various botanical journals in India as well as abroad, and edited 'Developing Village India'—an authentic publication on Rural Development, published by the I C A R

Sree Randhawa is a Fellow of the National Institute of Sciences of India (and of which he was a Treasurer in 1948), a Fellow of the National Academy of Sciences, India, a Vice-President of the Indian Botanical Society, Indian Society of Plant Breeding and Genetics and the Indian Statistical Society

M L ROONWAL

President, Section of Zoology and Entomology

HONY MAJOR DR M L ROONWAL was born on 18th September, 1908, at Jodhpur, Rajputana, where he received his early education at the Darbar High School He took his B Sc (Hons) in 1929, and M Sc (Hons) in 1930, both from the Lucknow University and Ph D in 1935 from the Cambridge University, being in residence at the Emmanuel College, Cambridge He was the Lucknow University Research Fellow in 1930 , and the Alexander von Hum-

boldt Foundation Scholar, Berlin University, in 1934, working in the Kaiser Wilhelm Institut fur Biologie, Berlin-Dahlem For several years he served on the locust research staff of the Indian Council of Agricultural Research, first in Lyallpur and later as Officer-in-Charge of the Locust Field Research Laboratory at Pansi, Baluchistan Coast In 1939, he joined the staff of the Zoological Survey of India, where he is in charge of the Birds and Mammals division of the Survey During the war he served as Major, in the 15th Punjab Regiment of the Indian

Land Forces, in the South East Asia War Theatre, and was made Honorary Major on demobilisation Dr Roonwal is a Fellow of the National Institute of Sciences of India and is the Secretary of the Zoological Society of India He is the author of several research papers published in the *Transactions of the National Institute of Sciences*, the *Philosophical Transactions* and the *Proceedings of the Royal Society of London*, and other standard scientific periodicals He is distinguished for his work on Entomology, specially Arthropod embryology and variability and population studies on locusts , and on the field ecology and systematics of mammals

M B SOPARKAR

President, Section of Medical and Veterinary Sciences

DR SOPARKAR after graduating from the Bombay University in 1906 worked for sometime as the Chief Medical Officer in an Indian State Later he was successively a Fellow and a Tutor of the Grant Medical College and Clinical Registrar, and Honorary Assistant Physician at the J J Hospital, Bombay In 1911, Dr Soparkar took the degree of Bachelor of Hygiene of the Bombay University and in 1913 he obtained the M D Degree

Dr Soparkar was an Honorary Research worker on Tuberculosis for two years at the Haffkine Institute, Bombay, and later held the post of an Officer in the Imperial Bacteriological Department (now Medical Research Department) which till then was reserved for officers of the I M S alone

In 1918, Dr Soparkar devised a special medium (Soparkar's Medium) for the cultivation of the Influenza bacillus

After the first World War when many Indian soldiers infected with human Schistosomes returned to India, Dr Soparkar investigated the problem of the likelihood of the disease spreading in India He found larval forms of several trematode parasites including animal Schistosomes which he studied and described in detail

Dr Soparkar described the method of cultivation of the tubercle bacillus and studied the vitality of the organism under natural and artificial conditions and the channels of spread of the disease in human beings He also studied the various aspects of animal tuberculosis In 1920, he was appointed Assistant Director (Acting), Haffkine Institute, Bombay

In 1922, Dr Soparkar was appointed Offg Assistant Director at the Central Research Institute, Kasauli Here he described a new species *Cercaria Patialensis* sp nov

In 1923, Dr Soparkar was deputed to the Imperial Institute of Veterinary Research, Mukteswar, to work on problems of animal tuberculosis as Officer-in-Charge, Bovine Tuberculosis Inquiry Scheme under the Indian Research Fund Association . There he discovered for the first time that tuberculosis among

animals was not a rare disease in India He also demonstrated that the bacillus causing bovine tuberculosis in India was highly virulent He has also worked on various aspects of tuberculosis in man

When the head-quarters of the Tuberculosis Inquiry were moved to the Haffkine Institute, Dr Soparkar carried out tuberculin surveys among different groups of population

In 1935, Dr Soparkar was appointed Assistant Director, Haffkine Institute and worked on Plague His work includes investigations on Cholera at the King Institute, Guindy, Madras

Dr Soparkar was awarded the Dossabhoy Hormusjee Cama Bombay University prize in 1914 for an essay on Helminthiasis and the 'Minto Gold Medal' for Medical Research in India in 1927 He was also the recipient of King George V Silver Jubilee Medal Dr Soparkar is a Fellow of the National Institute of Sciences of India

R S VASUDEVA

President, Section of Agricultural Sciences

DR R S VASUDEVA is one of the scions of a distinguished family of the Punjab Born in 1905 at Sahiwal, District Sargodha, Dr Vasudeva received his early education in the D A V School and later graduated from the Government College,

Lahore, in 1926 with Botany and Zoology as his special subjects He proceeded to England in 1927 for advanced training in Mycology and Plant Pathology at the Imperial College of Science and Technology, London, under the guidance of Dr W Brown, F R S and in 1929 obtained the Ph D Degree of the London University and Diploma of the Imperial College of Science for his original investigations on the physiology of parasitism of certain fungi and antibiosis He continued to work in the same laboratories up to 1932 and extended his researches on the physiology of parasitism During this period he also worked as Research Assistant to Dr W Brown and visited leading agricultural institutions in Great Britain and on the Continent On his return to India in 1932, he was appointed Mycologist for investigation of cotton root-rot (a soil-borne disease) which was responsible for an annual loss of 28 lakhs of rupees in Punjab alone The work was successfully completed in 1940 and simple measures of control were evolved The work was greatly appreciated both by the Punjab Government and the Indian Central Cotton Committee In 1940, he was appointed as Assistant Plant Pathologist at the Imperial Agricultural Research Institute and later as Plant Pathologist where he undertook investigation on Virus diseases of plants, particularly those of Solanaceous group On the merits of his valuable researches, the London University admitted him to the Degree of Doctor of Science in Plant Pathology Dr Vasudeva is now the Head of the Department of Mycology and Plant Pathology at the Indian Agricultural Research Institute, New Delhi

B B SARKAR

President, Section of Physiology

DR B B SARKAR, Head of the Department of Physiology at the Calcutta University, was born in 1895 His parents settled in Darjeeling where his father late Dr Bepin Behari Sarkar was a medical practitioner and his mother late Hemlata Devi, (daughter of the notable Brahmo leader late Pandit Sivanath Shastri) was the founder of the Maharani Girls' School, Darjeeling

Dr Sarkar received his early education at Santiniketan and later at Darjeeling He graduated from the Presidency College, Calcutta, where he worked for a couple of years as a Demonstrator in the Physiological Laboratory before proceeding to England after taking his M Sc degree in 1918

From 1919 to 1929, he worked in the same capacity at Edinburgh University and was admitted to the D Sc Degree in 1921 He was elected a Fellow of the Royal Society of Edingurgh Some of the results of his investigations were published in the *Proceeding of the Royal Society*, and he established the identity of a new Ganglion in the vagus nerve which was later named after him as "Sarkar's Ganglion"

In 1928, he proceeded to England again and carried on further researches in Physiology. After his return from England in 1922 Dr Sarkar joined the Post-Graduate Department of the Calcutta University

and in 1940 he succeeded Professor S C Mahalanobis as Head of the Department. He took a leading part in the organization of the Physiological Society of India, of which he is a past President.

T K N MENON

President, Section of Psychology and Educational Sciences

BORN in 1905, Principal Menon was educated in the Presidency College, Madras, and later in the Universities of Leeds and Berlin. He travelled all

over Europe and was invited to attend the International Summer School at Geneva as a Group Discussion Leader. On his return to India Mr Menon was awarded a Research Fellowship in Education and Psychology by the University of Madras. Later in 1935 he joined the Teachers' Training College, Baroda, as a Professor, and of which he is the Principal since 1939. He is also a recognised Professor of the Bombay University.

Professor Menon was the Chairman of Secondary Education Committee appointed by the Government of Baroda to report on Secondary Education in the State. He is the Editor of *"Journal of Education and Psychology"*, Baroda, and author of several papers on subjects in Education and Psychology communicated to various journals in India.

M SEN GUPTA

President, Section of Engineering and Metallurgy

PROFESSOR MONORANJAN SEN GUPTA was born on 28th June, 1903, at Rangpur in Bengal. After graduating from the Calcutta University, he proceeded to England and got the B Sc in Engineering of the Glasgow University with First Class Hons in Electrical Engineering in 1930. He won the class prize standing first in order of merit while studying Aeronautical Engineering at the Glasgow University.

Professor Sen Gupta had considerable practical experience at Metropolitan Vickers Electrical Co Ltd, Manchester, for three years. He has published several papers. Professor Sen Gupta is now the University Professor and Head of the Department of Electrical Engineering and Principal, Benares Hindu University.

He served as Professor and Head of the Department of Electrical Engineering, Bengal Engineering College, Sibpur, Howrah, from 1934-44

Professor Sen Gupta is a Member of the Institution of Electrical Engineers, London, Institution of Engineers, India and a Fellow of the Indian Physical Society

During the war, Professor Sen Gupta was responsible for the training of war trainees and personnel and following the war served as a member of the Development Board of the Government of Bihar

NIRMAL KUMAR BOSE

President, Section of Anthropology & Archaeology

SREE NIRMAL KUMAR BOSE was born on 22nd January, 1901 A scholar in the Matriculation examination, he took his B Sc with a First Class Honours in Geology from the Presidency College, Calcutta, in 1921 While a student in the Post Graduate Geology class he joined the Non-cooperation movement launched by Gandhiji and left the

college which was a Government institution He joined the National Muslim University at Aligarh where he was entrusted with the work of teaching Petrology which was his special subject in his Post Graduate studies Subsequently, he joined the Calcutta University and took his Masters' Degree in Anthropology in 1925, topping the list of all the successful candidates in all branches of science He was awarded the *University Gold Medal,* the *Hem Chandra Gossain Gold Medal* and the *Brahma Mohan Mallik Gold Medal* for his brilliant result Since then he has been engaged in research work all these days whenever he could make time amidst his preoccupations with political and social activities

He first chose social Anthropology as his field of research and one of the earliest papers contributed by him was the "Spring festival of India" Subsequently he took to Archaeology, particularly the architecture of ancient India as recorded in the temples One of his outstanding works, entitled 'Canons of Orissan Architecture' has commended wide appreciation In addition to studying Orissan temples he made a detailed investigation of the temple-architecture throughout Northern India, including the Kangra Valley in the Punjab, Rajputana, C P and Central India One of the original contributions made by him is with regard to the chronometric dating of these temples and the working out of the successive waves of architecture style diffusion from regional centres with the help of isopleths He was awarded the *Rampran Gupta Prize* by the *Bangiya Sahitya Parishad* for his contributions in this field

While engaged in these researches, Sree Bose had also to respond to the frequent calls of the country and courted imprisonment in 1932 It was in 1938 that he joined the Anthropology Department of the Calcutta University and built up a school of Prehistory in which he developed considerable interest Under his guidance and supervision the Department conducted investigations of some sites in Mayurbhanj and the results have just been published in a monograph by the Calcutta University entitled "Excavations in Mayurbhanj"

There was yet another interruption in his work when he, once again, found himself in the stream of August revolution He had been acting on the editorial board of Bengali version of the *'Harijan'* and was sent to prison in August 1942 Released in 1945, he joined the Department of Geography of the same University as teacher in Human Geography where he is engaged in building up a school of Anthropo-Geography He is the Honorary Secretary of Calcutta Geographical Society

Sree Bose is also a keen student of Gandhian literature and has interpreted Gandhiji to the general readers Two of his widely known publications are 'Studies in Gandhism' and 'The selections from Gandhi' It may be recalled here that all through the stay of Gandhiji in Bengal in recent years he was chosen by Gandhiji to act as his Secretary and Interpreter Sree Bose is also a literateur of repute, and contributes frequently to the well known periodicals, English and Bengali One of his travelogue, *"Paribrajaker Diary"*, replete with his deep appreciation of the varied facets of human character is a valuable contribution to the Bengali literature

Sree Nirmal Kumar Bose, as is expected of him, is keenly interested in adult education and *Harijan* work and has himself started a school for the purpose in Birbhum District

SCIENCE AND CULTURE

A Monthly Journal of Natural and Cultural Sciences

Vol 14 FEBRUARY 1949 No 8

THE FUNDAMENTALS OF RURAL HEALTH

HEALTH is a major basis of human progress, and its lack is one of the causes that lead to national decay Other things being equal, good health makes for physical efficiency, bodily comfort and a sense of well-being and it develops energy, alertness and keenness On the other hand, sickness and death bring many evil results, such as poverty, crime, laziness, inadequate output of work, broken homes, hopelessness and despair The maintenance of an adequate standard of physiological health and fitness is, therefore, of the greatest importance in a free country

India's health status has been low for many decades, so also her standard of living Successive scientific discoveries and their application in Western countries seem to have had little effect on our country The lack of a scientific outlook, inadequate investigations by the administrative authorities in developing suitable methods of organisation and the lack of a national policy of co-ordinated planning have been responsible for much of India's backwardness It is a matter of great pity that, in spite of our being masters in our own home for nearly a year and a half now, we have not yet been able to change the old outlook, the old administrative framework and the old methods of work which were, perhaps, more suited to the objectives of a foreign Imperial administration

It has been seen in other countries that the raising of the standard of living with regard to food, clothing, housing, education and social security has eliminated a large proportion of ill health, and that with regard to the remainder the improvement of environmental sanitation and working conditions has covered a substantial ground We, therefore, agree with the views of the author of the paper on "Rural Health Planning", published in the present issue of our journal, when he says that "no improvement in health can be achieved without the *simultaneous development* of the programme of national reconstruction in the fields of agriculture, animal husbandry, education, commerce and industry, housing and the improvement of communications—factors which are essential for improving the standard of living of the people "

With the impact of science on society, our social structure is changing and is bound to change further with industrialisation of the country India is at the cross-roads now and we have to think whether we shall allow matters to drift or we should plan and re-organise our community life in terms of *our* conception of life and democratic ideals There is no doubt that we should accept the latter alternative in re-organising our community life in urban and rural areas This is how we can avoid some of the evils of industrial civilisation in the West

Since over 90 per cent of our population still reside in the villages, since 90 per cent of the industrial labour in the country is drawn from rural areas where they return during harvest time and since the development of rural areas will lead to an all-round increase of national wealth and an equitable distribution of the same, planning should begin from rural areas, which had hitherto been neglected An idea can be had when it is stated that the expenditure on medical and public health protection in urban areas which represent 1/15th of the population, before the last war, was eight times that in rural areas

Years of slavery, leading to long-continued prevalence of adverse socio-economic conditions with consequent high rate of sickness among the rural population, have brought about a spirit of passive acceptance of various evils as inevitable The attainment of freedom has not yet been able to remove this attitude of apathy and frustration and to trans-

form it into a dynamic desire and active co-operation with our own Government as is to be expected from responsible citizens The mental outlook of this type of population cannot be changed without economic development and the extension of social services Since the acquisition of health and education is purchasable at a much higher cost than our present income *per capita* or taxation would allow, part of this purchase has to be effected in kind, *i e*, by the willing participation of the citizens in developing community programmes How quickly the improvement can be effected, will depend a good deal on the geographical region and the social status of its population The development of multipurpose co-operative societies has been suggested as one of the procedures for promoting the necessary spirit of co-operation and self-help Perhaps, each unit of population groups may need study and varied treatment It is for this reason that we support the idea of having a Pilot Centre in each unit of population The minimum population which can be effectively managed can be found out by a geographic and social study survey With such wide variations in social anthropology and other characteristics of population in different areas and in the requirements of these areas, it seems to us that the idea of having a Pilot Centre for each unit which can act not only as the Control Centre for survey and experimentation but also as the Centre for projection and co-ordination of activities

A good deal of the success of the scheme will depend on how we utilise the dormant population of each village Preliminary work in several parts of the country has indicated that the villagers are not interested in any scheme where their economic improvement is not planned for A rough planning programme may be drawn up by experts at a higher level to permit of minor alterations as a result of survey at the peripheral units The object of such a plan will be to prepare a stage-wise scheme to enable the population ultimately to take over from agricultural to technological economy

The responsibilities of citizenship and co-operative effort can best be stimulated by including the adult population of each area into a General Committee, the able bodied members of which must agree to render voluntary service for a certain number of days in the year This body will elect one member from each village or part of a village in order to cover up the whole area and form the Executive Council This will bring self-government right down to the level of individual villages Governmental participation, study, experimentation and co-ordination, along with training of personnel, will be carried out through the Pilot Centre in each unit The nearest approach to this scheme has been visualised in the U P Gaon Hukumat Bill, 1946 Mahatma Gandhi's "Samagra Gram Seva" scheme can also be considered in this connection

We have published schemes on rural planning from time to time We commend the paper on Rural Health Planning, published in the present issue, to the serious perusal of all administrative authorities and patriots We have to seriously think how we can raise the income *per capita* of the people to four times their present level in order to give them the minimum requirements of positive health, how to plan and locate cottage and large-scale industries and attend to the associated housing and recreational problems, how to utilise the natural resources of the country and how to develop a type of healthy and educated citizens who can best illustrate the cultural trends in India and thus take their position of leadership not only in SCIENCE but also in CULTURE

INTEGRATED RURAL HEALTH PLANNING*

A C UKIL,
LATELY PRINCIPAL, MEDICAL COLLEGE, CALCUTTA

NO planning for the health uplift of a community is possible without a consideration of the topography, soil study, the raising of food, weather conditions, population (men and cattle), water supply, drainage, industry, education, and economic and cultural backgrounds of the community A survey of these factors is necessary before any planning is undertaken It will be found that in most spheres, the deviation from physiological health is related to problems connected with housing, clothing, physical cleanliness, drainage, water supply, disposal of sewage, household refuse and manure and the contamination and poverty of food-stuffs The backwardness of India in the proper evolution of public health must be accounted for either by the progress of science not being applied to the prevention of diseases, as has been done in advanced countries, or to a wrong application of the same

In Western European countries, like Britain and Germany, successive scientific advances enabled a fuller apprehension of positive health which profoundly affected the action of State-craft Political and economic advances were followed by legislation and State action leading to improvement of working conditions and occupational hygiene, school health including the provision of school meals and preventive treatment of defects, the prevention of maternal and infant mortality, health, unemployment, old age and invalidity insurance, immunisation against diseases, the provision of adequate and safer food and the prevention and care of mental deficiency, tuberculosis, venereal diseases and cancer Subsidised housing and town planning schemes made it possible for the eradication of slums, the construction of sanitary dwellings, the provision of cheap-rental houses and the abatement of overcrowding, which resulted in a great improvement in sanitation and cleanliness This programme was accompanied by the establishment of a large variety of institutions and supply of trained personnel

Public health has been described in America as a "purchaseable commodity" Modern public health, which is an integral part of the social services like education, agriculture, animal husbandry, cooperation and industries, has to be paid for Great Britain spends 18 2% of the revenue for education and 22 7% for medical protection Is it possible for India to make a purchase of the same standard with 8 4% of the revenue for education, 3 4% for medical protection and only 1 7% for the improvement of agriculture and animal husbandry ? No improvement in health can be achieved without the simultaneous development of the programme of national reconstruction in the field of agriculture, animal husbandry, education, industry, housing and the improvement of communications—factors which are essential for improving the standard of living of the people, without which the improvement of health will be a fleeting objective, at least in the rural areas This *integrated development* will be found to be possible with the least expenditure by the establishment of multipurpose cooperative societies to act in the different spheres of social activity, as 80% of the programme will have to be executed and practised by the people and 20% by the State services of the regional unit, although I admit that the State must ultimately provide for a social machinery to assure living standards adequate for the maintenance of health Through this programme the people will learn the spirit of co-operation and self-help, thereby contributing their share *in kind* what richer countries have been able to accomplish by *cash purchase* *No health programme, therefore, can be sponsored and carried out without simultaneous development in other spheres of human activity intended to improve the standard of living* Since only 7 to 8% of the population belongs to urban areas, we shall try to estimate the requirements of rural areas primarily The urban areas receive much more from the provincial exchequer than it is their due Their sanitation and health programme needs special treatment and is much more expensive, but the municipal and industrial areas can raise money for health and social welfare more easily than rural areas

Topography and Social Anthropology

Take the question of West Bengal Out of 13 districts excluding Calcutta, the population varies between 0 4 to 1 million in 5 districts, between 1-2 millions in 6 districts and 3 1 to 3 6 millions in two districts (Midnapore and 24 Parganas), excluding Calcutta which registered a population of 2 1 millions during 1941 Census Each District is made up of 2-5 Subdivisions, with a population varying between 2-8 lakhs 3-12 Thana areas constitute a Subdivision The population of the thanas or police areas varies between 1,259 to 200,000, but the majority have a

* Address delivered at an Ordinary Meeting of the National Institute of Sciences of India held on 5-3-48 at Calcutta

population of 40,000 to 50,000. There are 238 thanas. The smallest administrative unit at the periphery is the Union Board which has a population varying between 5,000 to 20,000. The area covered by an Union Board with a population of 10,000 is approximately 15 sq miles. The male and female population is approximately equally balanced. One third of the population is constituted by children under 10 years. In sponsoring programmes of reform, a study of the topography of the area, the social anthropology of the population, economics, communications, health status and other factors should be made before the programme is put into operation.

The poor educational and economic status of the population, uneconomic holdings, unhygienic housing and extremely unsatisfactory environmental conditions made matters worse.

The average duration of disabling illness was found to be 50 days or nearly 2 months per sick person or 19.6 days per head of the population. For each death that occurred, 800 man days were lost through sickness. The largest number of man-days lost per head was in school children. Thus the total man days lost among 10,000 population were 2,19,000. The economic implications of such a large amount of wage loss mean a colossal loss to the country.

ESTIMATED SICKNESS RATES

I have before me the Report of 4 Surveys—one done at Closepet (Mysore) by the Rockefeller Foundation, one by the Bhopal State, a third and a most comprehensive one by the All-India Institute of Hygiene and Public Health at Singur analysed by Lal & Seal (1944), and the fourth by us at Bratacharigram. The average sickness rate may be taken at 15%, of which 83% is of a minor nature, indicating indifferent health and some symptoms of malnutrition which can, however, be attended to at a Health Centre, if this is not far from the domicile of the patient. 13% will be found to be "chronically suffering" from illness and will need either hospitalisation or domiciliary treatment for some time and 4% will be found to be "acutely ill" requiring immediate hospitalisation in a well-equipped and efficient hospital. If we take a population unit of 10,000, it follows that at any given time, 150 persons will be found to be "acutely ill", 250 "chronically ill" and 1,000 in "indifferent health but requiring attention". In such a unit, 200 delivery cases are expected to occur every year, of which 10% may be abnormal, only one-third of which, again, can be tackled by a trained midwife.

The very able and illuminating analysis of data collected at the Singur Health Unit (West Bengal) by Lal & Seal (1944) showed that 12% of the population were unwell at any given time, of which 1% were acutely ill, 2% chronically ill and over 8% in indifferent health. As regards the incidence of diseases, malaria constituted 61%, measles 10%, diarrhoeas and dysenteries 3.8%, other fevers 1%, typhoid fever, influenza and pneumonia each 0.6% of the total sickness. 44% of the population harboured hookworm and 3.7% roundworms. The disease rate was found to be the highest in infancy (96% during the first year of life), quite high in the lower age groups (44% among school children) and to gradually decrease with age. 40% of the population showed clinically recognizable malnutrition, including vitamin deficiencies.

PLANNING OF A HEALTH UNIT FOR 10,000 RURAL POPULATION

One must accept the dictum that the health programme must be a part of the general uplift programme simultaneously carried out by the other departments of Government, executed mostly by the people and partly by the Government, including a co-ordinated supervision by Government machinery.

According to the Bhore Committee programme, the primary peripheral unit should be a Health Centre with 2 emergency and 2 maternity beds, a maternity and child welfare centre and a school clinic. Its domiciliary visits are to form an important feature of the programme. There should be 2 qualified medical officers, specially trained for integrated rural health work, attached to each Centre, one of whom should preferably be a woman, a sanitary inspector to look after environmental sanitation particularly with regard to the disposal of night-soil and water supply, two qualified health assistants, two midwives, one compounder *cum* ward assistant, two servants, one of whom can be utilised as medicine carrier, one sweeper and at least two trained *Dhais*. Each rural health centre should be properly equipped with diagnostic tools, particularly a small laboratory with a microscope and equipments for blood, stool and urine examination. All the health staff should be provided with free and adequate accommodation in houses constructed scientifically but cheaply. The salary of the workers must be adequate to meet the needs of their social security and prevent them from resorting to corruption, and in this regard I would recommend the scales of salary advised by the Bhore Committee. The administrative machinery must provide for correct statistics and material so that at the end of each year the improvement of public health in an experimental area may be properly assessed on the basis of reduction in the incidence of sickness and of mortality and the improvement of general health of the community. The size of this unit

should not, therefore, be ordinarily larger than a population of 10,000

In the first year of the scheme, 4 to 5 of these primary centres may be joined together to form the next higher or Thana Centre, which should also have a bed capacity of 30, including obstetric beds

During the first year of the execution of the scheme, probably not more than one Thana in an area can be taken up in each district If two Thana areas are added every year, then at the end of the 5th year it will be possible to organise the secondary or subdivisional Health Centres And perhaps, if the income per capita of the people increases in the mean time, it will be possible to link together the subdivisional or secondary Health Centres with the District Health Centre

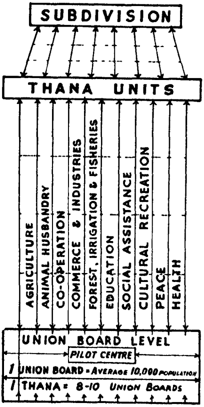
If the technical objectives of the scheme are not borne in mind, it will be sheer waste of money without achieving the result The present tendency in many provinces to appoint any qualified medical or public health personnel to do a specific job is a mistake and should be deprecated Every worker should be given some additional training to enable him to carry out the objectives of the new scheme, which unfortunately our medical educational institutions are not accustomed to give at the present moment

We have to build up the integrated public health framework from the village to the city, from the rural areas to the District Headquarters and from the Districts to the Metropolis The work should be integrated with the other fields of social activity, as has been pointed out, and broad-based at the bottom or base of the pyramid The various avenues of Governmental activity will represent vertical lines, as shown in the diagram below, and the co-operation of the people and inter-departmental co-ordination of the Government departments will represent horizontal lines It will be found that this system of pillars and cross-beams will be a firm foundation for an all-round improvement of the people If this is not done, efforts directed towards the amelioration of the sick will be found to be a never-ending business

One essential requirement of each Unit will be the organisation of a PILOT CENTRE on 50 Bighas or approximately 16 acres of land, which should serve not only as a demonstration centre for the different types of activities adaptable to the whole area but should also act as a centre for study, conference, co-ordination, education, cultural recreation and co-operation of the Centre workers and the villagers The village Panchayats, elected by representatives of the houses in the locality, will be allocated working zones in their respective spheres of activity Effective supervision, educative publicity and demonstrations will be exercised from the Pilot Centre This Pilot Centre will also study the local social and economic problems and adapt the plan to suit the requirements of the locality and the population Arrangements should be so made that the fundamental researches carried out at higher technical and other research centres can be promptly carried through the vertical lines to the Pilot Centre for distributing the fruits of research for application to the inhabitants in the field The removal of the enormous lag between science and its applications to the service of man will thus be facilitated The Health Unit will be one of the branches of activity at the Pilot Centre By close association of the various departments, the workers and the people will learn the value of integrated execution of

DIAGRAM OF

INTEGRATED RURAL HEALTH SCHEME



PERIPHERAL UNITS AT BASE

planned programmes and will participate in its activities The proper evaluation of the results will also be facilitated The development of the Pilot Centre is the most important part of the scheme One

important psychological malady which the general population is suffering from to-day owing to several generations of slavery is the lack of enthusiasm and lethargy which do not seem to have been affected in any way by the recent attainment of freedom A ruling Government has to be transformed into a servicing Government This requires careful educative publicity and appeal for co-operation for a common objective, *viz*, developing the newly-earned freedom Mahatma Gandhi's *Samagra Gram Seva* might be very usefully fitted into the scheme, with *co-operative combines* for every type of activity

For purposes of administrative co-ordination at different levels, it is necessary that there should be well-trained and mentally competent supervisors to see through the execution of the scheme Scientists, technicians and administrators will then find something worth doing and hope to achieve measurable success within a certain period I estimate that if the scheme visualised here is put into operation by the entire Governmental machinery, up to the Secretariat level, with the co operation of the people, it will probably take 20 years to cover the whole province If all the provinces and States undertake to put the scheme into operation, we can visualise some tangible results within 20-30 years What is needed now is to develop a revolutionary mentality to break off with the old imperialistic framework of administration and red tapism and to replace it by a living organisation which is expected to deliver the goods within a measurable length of time Some workers would like to wait for 5-10 years more until some more scientific surveys are carried out, but I think the scheme which has been placed here offers considerable opportunities of study and experiment* in every Pilot Centre, directed by higher technical personnel at higher levels of research and experiment In fine, what I wish to say is that health planning must be an integrated component of total national planning

* Village Housing in the Tropics by Drew, J B, Fry, E M and Ford, H L, Laud Humphries, London, 1947, may be suggested as a reference book for village housing and sanitation

THE COMET OF NOVEMBER, 1948*

THE recent comet which according to newspaper reports was first sighted by the pilot of an Australian air liner on the morning of 7-11-48 is one of the brightest that have been seen since the last appearance of Halley's comet in 1910 At Kodaikanal, on account of unfavourable weather conditions, observations of the comet could be begun only on 11-11 48, but they were continued till 14-12-48, with several interruptions caused by bad weather By the 14th, the comet had become invisible to the naked eye, and telescopic and photographic observations were also not possible subsequently because of bad weather

In all, visual and photographic observations of the comet were made on 13 days, while on two other days only visual observations were possible The results obtained are summarised below Table I gives the approximate right ascension and declination of the nucleus of the comet as computed from the photographs with reference to the surrounding star field

From the table it will be seen that the total movement in right ascension from 11-11-48 to 7-12-48 was 3 h 36 m (=54°), and that in declination 11°34′ If the observed coordinates are plotted

TABLF I

Date	Mean time of photograph (hrs IST)		Right Ascension of comet		Declination of comet		
	h	m	h	m			
11 11 48	05	30	13	03	23°	24	(South)
12 11-48	05	00	12	54	24°	18′	,,
13 11-48	05	00	12	47	25°	08′	,,
19-11-48	04	30	11	58	29°	20′	,,
21 11-48	04	30	11	40	30°	32′	,,
24 11-48	05	00	11	16	32°	00′	,,
25 11 48	04	30	11	08	32°	30′	,
26-11 48	04	45	10	59	32°	56′	,,
27 11-48	05	00	10	51	33°	17′	,,
28-11-48	03	30	10	43	33°	37′	,,
29 11-48	04	00	10	34	33°	58′	,,
1 12-48	04	00	10	17	34°	30′	,,
7-12 48	02	45	09	27	34°	58′	,,
Total movement in			3h	36m	11°	34′	,,

against the corresponding dates (*vide* Fig 1) and smoothed curves drawn, it will be seen that while

* Communicated by the Solar Physics Observatory, Kodaikanal

the rate of movement in right ascension was quite uniform that in declination steadily decreased during the period The rate of movement in right ascension obtained from Curve I, Fig 1 is 8 3 min per day (2°4′ 5) Fig 2 gives a graphical representation of the daily rates of movement in declination obtained by plotting the values taken from Curve II, Fig 1 against the corresponding dates The rates taken from the smoothed curve in Fig 2 are given in Table II

It will be seen that the rate of movement in declination decreased from nearly a degree per day at the beginning to less than a minute towards the end of the period Fig 3 shows the track of the comet against the background of fixed stars Typical photographs of the comet are reproduced in Fig 4

The tail of the comet when first sighted subtended an angle of 28° and was pointing approximately in a southwesterly direction The brightness of the head at that time was estimated at about 1 5

TABLE II

Date interval	Rate of movement in declination	Date interval	Rate of movement in declination
11 12 Nov 48	54	24 25 Nov 48	27
12-13 ,,	51	25-26 ,,	25
13-14 ,,	48 3	26-27 ,,	23
14 15 ,,	45 6	27 28 ,,	21
15-16 ,,	43	28 29 ,	18 8
16-17 ,,	41	29-30 ,	16
17 18 ,,	39	30 Nov -1 Dec 48	13
18-19 ,,	37	1 2 Dec 48	10
19 20 ,,	35 3	2-3 ,,	7 5
20-21 ,	33 7	3-4 ,	5 3
21-22 ,,	32	4 5	3 4
22-23 ,,	30 4	5-6	1 8
23 24 ,,	28 6	6-7	0 5

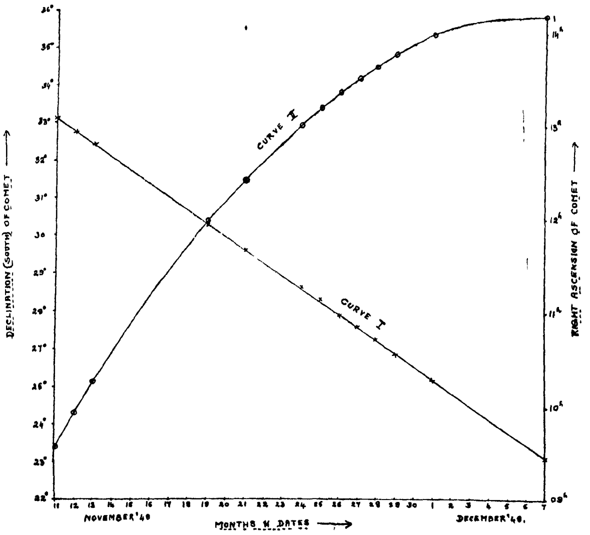


FIG 1

stellar magnitude On 7-12-48 when the comet was last photographed it had become very faint (about magnitude 5) and the tail had dwindled to less than 5° The computed angular distance of the comet from Venus on 11-11-48 was 20°48′, the corresponding figure on 7-12-48 was 73°36′ The direction of movement of the comet was approximately west-southwestwards On 14-12-48 when the comet was last seen through the telescope at Kodaikanal it had entered the region of the Milky Way

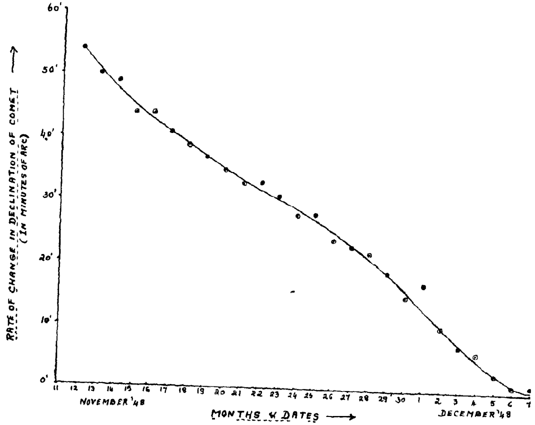
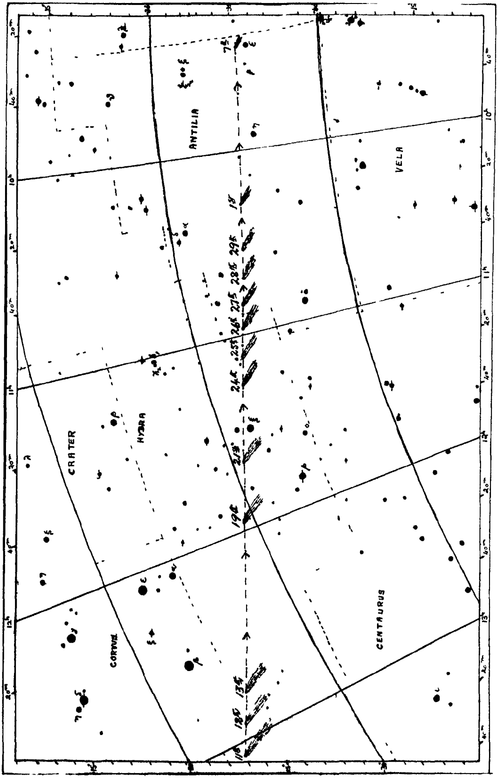


FIG 2



TRACK OF THE COMET
FIG 3

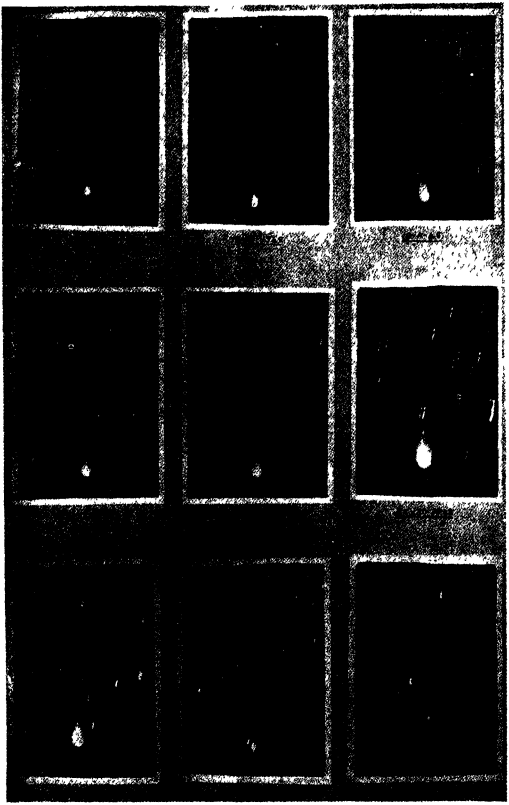


Fig 4

SCIENCE IN WORLD WAR II

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(Continued from the last issue)

RESEARCHES ON BALLISTICS

WE shall now pass on to a description of the important weapons and the researches and improvements in World War II The chief weapons as listed before were (*a*) guns, (*b*) bombs and (*c*) rockets Ballistics is the name of the science which deals with all the phenomena concerned Interior Ballistics treats with the motion of the projectile in the launcher—the barrel in the case of the gun Exterior Ballistics is concerned with the motion of the projectiles from the launcher to the target Terminal Ballistics is concerned with the motion of the projectile close to the target, the effect of its impact on the target, and the distribution of fragments and gases in the neighbourhood of the target

The gun is the oldest weapon utilizing *fire* to hurl destruction at a distance A gun consists of a long tube wherein an explosive propellant powder is burnt and the pressure of the gases generated is utilized to throw out a projectile shell a long distance away It embraces all the weapons that go in the name of the pistol, the revolver, the rifle, the machine-gun, the field gun, the howitzer and mortars of all classes The projectiles thrown out of the larger sized weapons, such as the field gun, howitzer and mortars, themselves contain an explosive charge and explodes on or after hitting the target or just before that The shells may be grouped into three types—the high explosive shell, the fragmentation shell and the armour-piercing shell The high explosive shell has a thin skin and contains a lot of high explosive inside it When it explodes, the blast does the actual damage *e g*, blows off walls etc The fragmentation shell has a relatively heavy casing which breaks up into a large number of fragments on explosion of the shell and these fragments does the killing The armour piercing shell is used to cause destruction after penetrating heavy armour, *e g*, the steel plate of a tank or a battleship The usual type is a shell with a solid pointed nose of high grade heat treated steel with a comparatively thin walled base of soft steel containing some amount of explosive powder This end explodes after penetration and the fragments and blast produce the desired destruction and killing Shells contain what is called a fuze, a mechanical device for detonating the shell, fixed to its head or base and set to explode on time or contact

SCOPE OF BALLISTICS RESEARCH

INTERIOR BALLISTICS

(1) Pressure-time curves at different positions of the barrel and different charges of powder
(2) Skin Temperature—time curves
(3) Measurement of bore friction
(4) Erosion of barrels
(5) Rate of burning of the propellant powder
(6) Equation of state of the gases

EXTERIOR BALLISTICS

(1) Path of projectiles of different shapes and sizes
(2) Aerodynamic forces on the projectile
(3) Stability of the projectile in flight

TERMINAL BALLISTICS

(1) Attitude of the projectile striking the target—such as flat ground, vertical wall, etc
(2) Penetration of the target armour
(3) Fragmentation and blast
(4) Distribution of fragments
(5) Probability of hitting the target

The list shown will give the readers an idea of the scope of Ballistics research It is not possible for the writer to produce representative data of these measurements They are military secrets the details of which are never let out to the general public I shall therefore only outline the methods of measurements and enumerate the important changes of design that resulted from extensive research on the above mentioned subjects in World War II With the help of these data gun designers of today can design the gun barrel, the shell, find out the composition, characteristics and quantity of the propellant and explosive charges, in order to have a prescribed destructive effect at a prescribed distance

The pressure inside a gun barrel is measured usually by a piez-electric gage A hole is drilled into the barrel and the gage fitted thereon The pressure on the piezo crystal generates a voltage which is recorded on an oscillograph—the record giving the pressure time curve Copper crusher gages are also used to measure peak pressure—which consist of accurately turned copper cylinders that are crushed by a piston operating from a hole in the gun barrel The latter is used now-a-days only as a check and a calibrating apparatus

The skin temperature is measured by a special iron nickel thermo-couple mounted in a small hole flush with the bore of the gun The oscillograph record gives the temperature-time curve

The bore friction is measured as the difference of the pressure at the base of the projectile and the

pressure corresponding to the accelerating forces These are measured by means of two piezo-electric gages fitted inside the projectile

The velocity and acceleration of the projectile inside the barrel can be found out from a simultaneous record of the pressure time curves at different points on the barrel The bore friction may also be inferred from these measurements

The erosion of the barrel is found out by inspection and measurement of the diameter of the bore after several firings

The path of a projectile in free flight over a proving ground is found out by taking intermittent photographs at night time of the tracer attached to the projectile in two or more photo-theodolites These are essentially high grade plate cameras fitted with synchronized occulting shutters By reduction with a stereo comparator, the observed trajectory could be deduced This optical method is essentially limited in accuracy as to measurement of distance, and a radar method utilizing similar ideas will certainly improve the accuracy a great deal and is perhaps actually used now-a-days

A much more accurate experimentation on exterior ballistics is possible by firing the projectile inside a long tunnel, fitted with a number of spark photography apparatus at different places It is then possible to measure the time and photograph the projectile as it passes across these positions However the method is limited mainly to projectiles of small calibre

As regards the measurement of Aerodynamic forces and stability, these must be found out in a supersonic wind tunnel by the usual methods of pitot

Fig 2 The supersonic wind tunnel at Kochel, Germany

tubes fixed on a model of the projectile, supplemented by spark photographic methods using ordinary light or X-rays (Blitzgeber and Rontgenblitz) for finding out density variations near the projectile A wind tunnel in which air is moving at a speed greater than the velocity of sound will surely make anybody knowing Aeronautics inquisitive The chief idea is to allow compressed air expand in a suitably shaped jet The expansion in the jet is accompanied by a streamlined flow at supersonic speeds in a limited region of the jet The Germans made extensive studies on projectiles of different shape in these supersonic tunnels

High speed spark or flash photography using ordinary light or X-rays are essential for an experimental study of Terminal Ballistics The arrangement utilized by Germans for studies of Terminal Ballistics consist of a condenser charged to 40,000 volts discharged through a spark gap to produce a very brilliant flash of very short duration The discharge is timed by a firing signal from the thyratron injected into the spark circuit The time of discharge of the thyratron is controlled by the time constant of R C circuit at its grid Light from the bullet striking the armour passed through a polarising nicol on to a kerr cell camera The analysing nicol inside the camera is so adjusted that no light passes on to the camera without any voltage on the Kerr cell When the spark occurs, a momentary high voltage on the Kerr cell allows passage of the light synchronized with the flash and takes the picture Several successive pictures taken at intervals of a fraction of a microsecond in several such cameras is able to give a visual elucidation of the process of armour penetration by a bullet, the fragmentation of the bullet when it fails to penetrate the armour, as well as distribution of fragments inside the armour in case the armour is penetrated or outside it, in case the bullet is defeated and breaks up

The blast effect is usually studied by plotting pressure time curves by piezo-electric or condenser microphones of special design They are generally checked against bursting of paper and metal diaphragms of different thicknesses which represent the older method

Distribution of fragments is found out by causing an explosion of the projectile inside a cardboard box of suitable size which are penetrated by the fragments

Probability of hitting is determined by the usual proving ground tests of firing a large number of projectiles and finding out the distribution of the craters caused by them

The chief measurements connected with bomb ballistics are concerned with measurement of Aerodynamic forces on the bomb in a sub-sonic wind tunnel, finding out a design which is aerodynamically stable, as well as finding out the terminal velocity A bomb let down from aircraft must follow a

trajectory uniquely defined by its boundary conditions and should not have an oscillating motion around a given trajectory while it falls As regards terminal ballistics, the measurements that are to be made are the same as that for projectiles of guns but the method of measurement is mainly confined to an examination of the craters in concrete involving taking of stereoscopic photographs of the craters for comparison

The problem of the design of a satisfactory rocket is concerned, like the bomb, with a measurement of Aerodynamic forces in a sub-sonic as well as supersonic tunnel, finding out stable aerodynamic designs, as well as finding out amounts of powder charge required to produce a given destructive effect There are some problems of interior ballistics, *viz*, motion in the launcher in as much as it affects the dispersion and probability of hitting The path of the projectile in a proving ground can be easily found out by photo-theodolites in night time in a manner described before As for terminal ballistics, similar methods as that for bomb are available Over and above all, there is the great problem of the design of the rocket motor—which in itself is a vast subject In case of rockets using explosive powders as propellant, it involves the determination of the thrust, time of burning, rate of burning, grain structure of the powder—a science in which chemistry and physics are thoroughly interwoven Efforts of German scientists led to the successful design of the liquid fuel rocket motor—utilized in the famous V_2 The development of V_2 is a great scientific and engineering achievement and demands separate and lengthy discussion We shall therefore discuss it separately

A description of the development of these weapons of destruction can best be given by following their adoption and use by the belligerents as time and World War II progressed The outbreak of the war saw Germans coming to the field with 88 m m combined A A and field gun, machine guns, panzer divisions using light tanks, motorized infantry using automatic weapons supported by a powerful air force using chiefly dive bombers for attack The British and French came with 75 m m field guns, the A A guns, light tanks, motorized infantry, and a weak airforce whose activities were chiefly confined to secret service and reconnoisance There were no rockets except those for signalling Germany was the winning side, numerical strength, superior tactics, better weapons in general and bombs from the dive bomber being the chief reason Military operations made extensive use of radio communication for coordination between the fighting groups, *e g*, the aircraft and land units

France was liquidated, England's armies thrown into the sea and the British Isles badly bombed by luftwaffe and blockaded by the submarine force Bombing by luftwaffe and strangling by the submarine force could not cause an overthrow of the existing government Destruction by bombs was no doubt widespread but the industry was only partially and temporarily put out of action Great air battles were fought over England, by fighter aircraft using

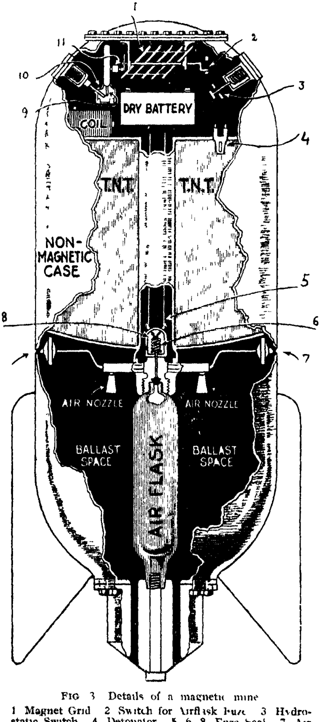

FIG 3 Details of a magnetic mine
1 Magnet Grid 2 Switch for Airflask Fuze 3 Hydrostatic Switch 4 Detonator 5, 6, 8 Fuze Seal 7 Air Vents 9, 10 Mercury Switch 11 Solenoid Choke Brake

machine guns *Radar* came to the limelight—a system of *ground control of night fighters* by Radar developed and perfected *Magnetic mines* sunk a million ton of allied shipping, before degaussing girdles could come to its rescue The *submarine* proved again to be a very difficult enemy The British navy found itself helpless to protect the merchant marines from the submarines torpedoes

Large scale land warfare began again with Russia's entry into the war Again superior weapons, superior tactics and the powerful luftwaffe brought victories to the German side As the fighting progressed, the rocket bomb *bazooka** came to stop the German tanks in the hands of the heroic and determined Russians As a tank destroyer it can only be used by dare-devils or suicide troops *Mortars* throwing heavy shells a short distance were found more useful—and heavier and heavier shells were wanted Russia's land armies ultimately began to keep in check the German armies, and the powerful luftwaffe could only force costly breakthroughs The guns, mortars and bazooka held the attack which were followed by vicious counter attacks by tanks having superior artillery The Russians sent to the field, *tanks having servo controlled gyrostabilized guns* Modern land warfare took shape in Russia, both parties understanding and learning each other's tactics ! It appears that Russians first armed their *Aircraft with mortar guns* firing heavy calibre shells and used them against tanks and motorized infantry The Germans learnt a bitter lesson—in modern warfare ideas frequently score over refined machinery and the Russians have ideas

Japan's entry into the war demonstrated the power of the aircraft as an offensive unit of the navy The sensational attack on Pearl Harbour and the sinking of the British battleships prior to the landing at Malaya completely changed the outlook of naval fighting The high altitude bombing, dive bombing and aerial torpedoing of the Japanese proved to be surprisingly accurate and devastating compared to those encountered in the Mediterranean Simultaneous landing operations at many places, followed by the quick breakthroughs of the landed army, again showed before the world the effectiveness of the new tactics The success of the Japanese also proved what determined class heroism can do when it strikes in desperation

Naval engagements that followed chiefly took place at night time—starting with the allied rout in the two night Java sea battle extending to the sea battles of the Solomons The Japanese mysteriously sank practically the whole of the combined allied fleet in Java sea, chiefly by torpedo attacks without any damage to their own It was proved that the navy had electrical eyes and ears—Radar and Radio—and perfect co-ordination of operations at night time is possible with their help It was in Medway that the Japanese actually found a competent rival knowing modern naval tactics Several Japanese aircraft carriers were sunk by bombs and torpedos from aircraft of American carriers which advanced to engage the Japanese carriers in mid-sea The Japanese commander apparently made the mistake of pushing home the air attack on Medway instead of concentrating to destroy the engaging carriers and paid a heavy price However these sea battles proved that the navy had both ears and eyes which operate in dark and for sometime it became the custom to engage at night These battles ultimately formulated the new tactics of naval warfare in which aircraft took a very prominent part The chief defense of the naval units from aircraft was the intense barrage of massed A A guns of the whole fleet moving in close formation Servo-controlled A A guns using computing directors ultimately came in making the task more difficult for the attacking aircraft

The course of fighting turned with the allied landing in North Africa The fighting in the Lybian

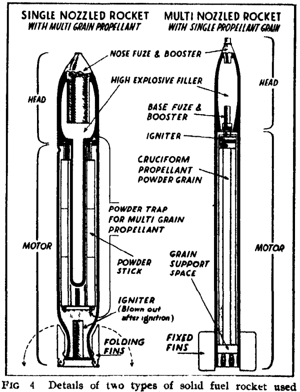

FIG 4 Details of two types of solid fuel rocket used in World War II

* The bazooka may be called a large size grenade thrown out a short distance (100/200 yds) by a rocket motor The modern refined variety contains a shaped charge warhead, an explosive cylinder having a conical cavity lined with copper at its striking head Explosion of this cylinder charge can blow out a hole in the steel armour plate of a tank

deserts and the leisurely retreat of Rommel's army through Cyrenica and Tripolitania made the Allies conscious of the effectiveness of *landmines* in stopping or slowing down a superior attacking force The allies devised a *mine-detector*, which would detect a metal piece of respectable size The Germans replied with the *schu mine*—a plastic case mine containing very little metal The land mine remains a problem still now

Large scale use of rockets for supplementing naval bombardment began with the landing operations in Sicily and Italy The Germans replied with *steerable radio-controlled rocket projectiles* having wings for destroying landing craft Radar and radar countermeasures were used extensively by both parties *Radio controlled steerable bombs* were also used for destroying allied shipping by Germans The land mines, the servo-controlled A A Gun, the new radio controlled missiles, the jammed Radar, gave the allies a bad time and a protracted Italian campaign inspite of great numerical superiority

The British made extensive use of Radar and Radio navigational aids such as Loran and Gee in the long range night bombing missions over Europe Radar bombing through overcast skies was made possible by the use of H_2S—a microwave plan position indicating radar that can be carried in an aircraft The Americans developed a system of daylight bombing by using massed formations of their famous flying fortresses—a plane having a large number of gun turrets and a very great fire power When these planes flew in close formation, no German fighter craft could approach them within hitting distance They found their guns useless and developed the *air to air interception rocket* Their first use in the air battle for Schweinfurt worked devastation in the tight formations of flying fortresses Thereafter these tactics had to be abandoned and flying fortresses had to take long range fighter escort to engage the rocket firing aircraft The German tactics of sending the night fighter with Radar eyes over and near-about the British air fields to destroy returning bombers was countered by *Resnatron jammers* of great power The Radar controlled A A guns defending German cities were paralysed by Radar jammers carried in bombers The war entered the field of electronics

The landings in Normandy again saw extensive use of Rockets—rockets from rocket ships, rockets from landing craft, rockets from aircraft supporting landing, and rockets from army vehicles and tanks The landing operations were covered by an attempt of Radar bluffing, which perhaps was not as fruitful as has been described because it was at that time a very well-known art The landing operations were very well planned, and made use of many types of special landing crafts and devices to convert the ordinary beach at least temporarily into an artificial harbour The complete mastery of air was of course a prerequisite, which the Allies fortunately had It is only for these excellent landing craft and the complete masterly of the air that the Allies got a foothold

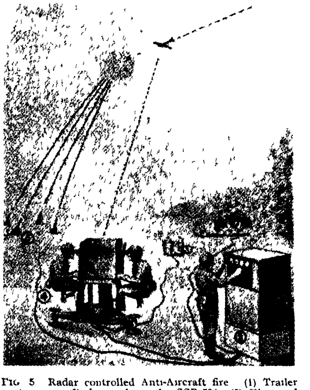

FIG 5 Radar controlled Anti-Aircraft fire (1) Trailer containing a Radar such as the SCR 584, (2) Electrical gun director computing azimuth, elevation and fuze setting of the anti aircraft batteries, (3) Stand by optical altitude finder, (4) Stand by optical azimuth finder and tracker, (5) Servo-operated gun battery

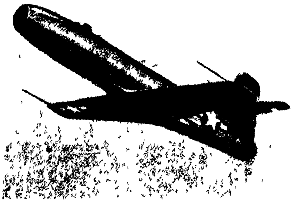

FIG 6 A high speed jet propelled fighter aircraft

on the beach and could successfully counteract the vicious attacks of the German army attempting to foil the landings More and more allied troops were landed and ultimately the German armies were pushed into the interior to defend their motherland

Germany put into the air several types of jet propelled planes but had to remain content using them only for aerial reconnoissance because of want of aviation petrol and flying personnel They perfected the jet propelled robot plane V_1 but it was tackled well by the radar controlled servo-operated A A guns then installed on the English shores firing shells with a radio proximity fuze Finally they tried to avenge the allied bombing of German cities by sending the famous V_2—a long range rocket

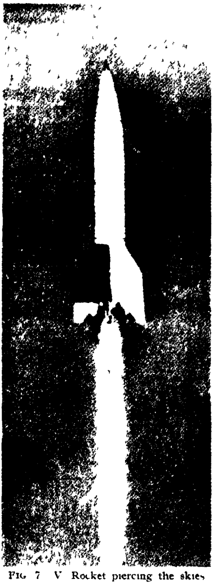

FIG 7 V Rocket piercing the skies

having gyro—programme controlled flight, carrying a ton of explosive at its warhead

On the other corner of the Globe, the Japanese were outnumbered, outwitted and bypassed by the allied forces using superior tactics and weapons The allied march towards Japan took place in a series of long distance hops—made possible by the complete mastery of the sea and air The Japanese soldiers in the jungles of the Solomons, New Guinea, Burma, Philippines found their enemy remaining contented with occupying a part and consolidating a few positions in these places, and marching on straight towards the motherland which they are helpless to stop and even interfere with Their supplies were cut off, and they had even to plough the land to grow food to sustain their lives Heavy aerial bombardment of the Japanese mainland began with the occupation of the Marianas Islands The battles for these islands were fought bitterly and the Japanese used the Kamekaze pilots to steer in the rocket-motor *Baka Bombs* on the American shipping

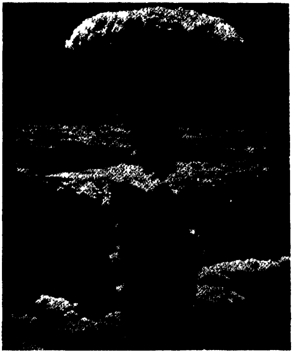

FIG 8 Radioactive gases ascending upwards after explosion of an atomic bomb

Nevertheless, numerical and technical superiority ultimately defeated heroism and if not the militarists at least the Japanese Emperor became sure of the ultimate end American incendiaries from the new superfortresses burnt out many Japanese industrial cities and the war ultimately came to an end with the *Atomic bomb* destroying Nagasaki and Hiroshima

CONCLUSION

The outstanding contributions of science to weapons of war that has come to light during World War II are (1) Radar, (2) Rockets with controlled flight and (3) the Atomic Bomb The continued research and development of these, particularly of the two latter, may change the nature of military operations in the third world war even more drastically than has the application of Radio communication, Radar, Aircraft and Tanks done to World War II It is very likely that the Radar-Radio and Gyro-controlled rocket will make all big guns obsolete It is no secret that the U S Navy is building battleships designed to fire six and two ton V_2 Rockets using no guns bigger than the 40 m m automatic canons mounted in sealed turrets It is almost certain that in a future war we shall find rockets (heat-homing, proximity fused), to become the the exclusive weapon of and for aircraft Atomic explosions will surely be taken advantage of where devastations over a wide area are considered to be necessary Defensive measures against such Atom bomb explosions are possible and are planned for by all important powers of today It is likely that mankind will survive the direct effects of a third world war quite well, although it may be greatly depleted by such after effects as hunger, disease and disorder

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INSECTICIDES

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ATTENTION of our Government has been directed to the provision of food and to prevent the loss due to insects It has been decided that insecticides should be sold free of duty charges for the moment It has been estimated that five per cent of the world's food production is lost due to insects Control of insect food pests and also the control of disease bearing insects, particularly in our tropical countries are of extreme importance

The purpose of insecticides is to kill insects Perhaps the earliest discovery in this field is that of Aristotle who found that insects are killed when butter is applied to the surface of their bodies An explanation for this that they are killed by chocking of breath came two thousand years later, when Malpighi showed in 1669 that insects breathe by means of tracheal tubes opening on the body surface Much investigation has been done on the action of chemicals for killing insects , an example will be of interest The interaction of the flying insects and insecticidal mist has been studied and it has been concluded that the insecticidal spray is picked up by the fly or mosquito in toxic dose when flying through such a mist , the mosquito at rest is not affected The greater the activity of the insect the greater is the kill The most effective droplets lie in the region of five to ten microns in diameter These drops are picked up by the unfortunate fly by impaction on the beating wings When a certain dose has been accumulated the insect appears to be uncomfortable and it alights and cleans its wings , the insecticide is thus brought into contact with the vulnerable points on the legs through which entry can occur

Insecticides are used on a very large scale in the form of sprays, dusts, poison baits and fumigants Long experience has demonstrated the very important role that insecticides, properly used, play in the control of insect pests and consequently in food production Obviously, their use must be considered in relation to the value of the crop, and this is reflected in the fact that at present they are more widely employed in Europe and America in horticulture and fruit-growing than on purely agricultural crops Suitable machinery for the application of insecticides is lacking on the average form, but in recent years there has been an increase in the spraying or dusting by contract by firms specialising in work of this kind, of such crops as sugar beet, potatoes, brussel sprouts, cabbages, peas and carrots grown on a field scale

The notorious pests of agricultural crops are wire worms, leather jackets and other insects that live in the soil There is not yet a satisfactory soil insecticide Although Shell D D (dichloropropane-dichloropropylene) is supposed to be an efficient soil fumigant giving full control of soil borne pests and some fungi It first aroused interest in America in 1942 Dr Walter Crane, of the Pineapple Research Institute of Hawaii, seeking a remedy for the destruction of the pure apple crop by eelworm, obtained this derivative of petroleum, a dark liquid mixture of unsaturated chlorinated compounds, possessing toxic properties In the past year or two very promising results have been obtained in protecting cereal and other crops from attack by wireworms by the use of

insecticides containing benzene-hexachloride drilled with the seed

Most widely used insecticides are nicotine, derris root, pyrethrum flowers, arsenical compounds, tar oil and petroleum oil preparations, and the new synthetic organic compounds dichlorodiphenyl trichloroethane (D D T) and hexachloro-cyclobenzene, more generally known as benzene hexachloride

In using insecticides in practice, the aim is not the indiscriminate destruction of all kinds of insects, for those species that are injurious to cultivated crops are comparatively few and among the vast number of other species there are many that are actively beneficial from man's point of view It is essential to reduce to the minimum the risk of destroying bees and other pollinating insects and also the parasites and predators that help to keep the pests in check

The proper uses and limitations as agricultural insecticides of D D T and benzene hexachloride have been intensively investigated It may be of interest briefly to summarise the position reached with D D T It is certain that D D T is highly effective under practical conditions for control of many agricultural pests, and is harmless to human beings and livestock, and does not cause any damage to crops treated It controls easily Flea Beetle, Colorado Beetle, Cabbage Butterfly Caterpillars and Apple Blossom Weevil

Insecticides and fungicides are progressive industries throughout Europe and America We shall mention their progress in Holland which is an agricultural country like ours Calcium arsenate which serves to fight the potato plague of the Colorado beetle, is at present being turned out in adequate amount at Arnhem On the eve of the war Britain and Belgium were among the principal suppliers of calcium arsenate The Dutch production of nicotine, only 6,000 tons, is not yet sufficient to meet the national needs, so that the use is restricted to green houses Rotenon base insecticides, cyclohexane hexachloride and D D T are made in abundance

Most insecticides used in agriculture are applied in the form of dusts A small amount of the poisonous substance is mixed with a large quantity of inert carrier dust It is already a common commercial practice to use aircraft dusting of crops in U S A and of locust hoppers in U S S R Little precise information is available about their results, but the practice continues and it may be presumed that it pays

The dust cannot be aimed from any considerable height and the aircraft have to fly very low, only a few feet above the ground In Africa it is often not possible to use such small aircraft because of lack of landing grounds, high altitude etc Again when the target is mobile like a swarm of locusts, longer range aircraft are necessary If they are operating 100 miles from base, they must carry a good load of poison, for otherwise a considerable time is spent in travelling between base and target Consequently spraying offers opportunities of better control of aiming from somewhat greater heights If suitable oil is used as solvent, the poison will stick to and penetrate the insect's cuticle more effectively First experiments in the use of helicopter for crop spraying are now being tried in Egypt, near Turabi, in the Blue Nile Province, on cotton land belonging to the Sudan Plantations Syndicate Advantages of such spraying are speed and ability to get close to the crops without damaging them

In America, the National Cotton Council had given a high priority to insect control in an effort to cut down farm losses which amounted to 283 million dollars in 1946, and 220 million in 1947 Twenty major insects which plague cotton-growers had been controlled Each time the ball worm destroys a bale of cotton, the farmer's production cost obviously increases As production costs go up, the price of the fibre and fabric rises Had serious insect infestations taken place during the growing season this year, the manufacturers of insecticides, fungicides and herbicides in America were prepared to meet unprecedented demands The stir in our National Government shows that we are more conscious than before of the importance of pest control in the production and preservation of food and crop

In conclusion, the writer acknowledges that he has freely consulted recent issues of the *Chemical Age*, the *Chemical and Engineering News*, the *Advancement of Science*, *Bulletin of the Imperial Institute*, etc

SEARCH FOR ANTIBACTERIALS IN PHANEROGAMS—PART I

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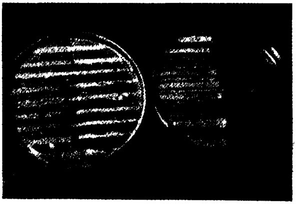
THE recent investigations in the search for anti-bacterial substances in Phanerogams[1-12] tend to show that active principles might be available for the treatment in bacterial diseases caused by both the gram-positive and the gram-negative bacteria. In India, a country rich in phanerogamic flora of different climates a systematic survey of higher plants may lead to interesting or even valuable results. With this end in view an investigation has been undertaken with plants selected mainly on the basis of Ayurvedic Materia Medica and a preliminary survey of 57 plants is being presented in this paper. The detailed study of the promising ones is in progress. Bentham and Hooker's classification has been followed in identifying and classifying the plants.

EXPERIMENTAL

Preparation of the Material.—Freshly collected plant materials were thoroughly washed, macerated and well ground up in a porcelain mortar with specially-purified sand and sufficient distilled water added to produce a pulp. The pulp was strained through muslin and the extract filtered through a fluted filter paper. By repeated filtration through the same filter paper clear extracts free from chlorophyll were obtained in all cases. This has been particularly done to exclude the possibility of chlorophyll acting as an antibacterial agent[13]. Where the pulp was found to be slimy, buchner funnel filtration was resorted to. It was found interesting to note that the extracts were all acidic to litmus except that of *Peperomia pellucida* Linn. which however was alkaline. The *p*H of all the extracts were adjusted to *p*H 7.4—7.6.

Assay Method.—Sanders *et al*[1] and Osborn[4] have preferred the agar diffusion method in view of its simplicity and suitability where only small quantities of test materials were available, though the latter admits the possibility of the inhibitors which would not diffuse through agar, giving negative results. In order to overcome this drawback the following method was adopted in this study which is purely a qualitative and not at all a quantitative one.

The double plate method of W. D. Frost[14] has been modified to suit this preliminary investigation. Sterile molten agar *p*H 7.4, was poured into a sterile petri dish. The agar bed after hardening was cut into two with an arrow head under aseptic conditions. The empty half of the petri dish was then filled with a definite quantity of nutrient agar mixed with known amount of plant extract, the total measure of these two being the same as the original amount of agar taken out so that the surface level of the two halves after refilling remained the same. Nine zones at right angles to the axis of the confluence of the two halves were drawn with a glass pencil on the back of the petri dish and 9 selected cultures were separately streaked on the surface of these zones, one in each (Figs. 1 & 2). Care was taken to dry the agar bed sufficiently before inoculation to avoid the possibility of the water of condensation forming a bridge-head between streaks and give rise to erroneous results.



FIGS. 1 & 2. 1 showing growth on the plant-extract agar side (A) while 2 showing complete inhibition of the bacteria seeded on the plant extract agar side (A). B nutrient agar side, lines showing the nine different zones.

With a view to study the activity of the plant extracts against as many pathogens as possible the following gram-positive and gram-negative species have been taken up for study (*Bacillus subtilis* however, has been included in conjunction with the work done so far by others). *Staphylococcus aureus*, *Staphylococcus albus* Woods, *Bacillus subtilis*, *Escherichia coli communis*, *Salmonella schottmulleri*, *Eberthella typhosa*, *Shigella dysenteriae* Var. *Shiga*, *Vibrio cholerae* Inaba, and *Klebsiella pneumoniae*.

The experiments in all cases were carried out with fresh material either immediately after collection or within 24 hrs. In cases where the plant extracts were not tested immediately, they were kept below 5°C till they were tested.

2 mls. of each fresh plant extract after adjustment of *p*H to 7.4—7.6 was mixed thoroughly with

TABLE

Family	Name of the Plant	Part of the Plant used	Species of Microorganisms tested showing results								
			Gram+ve			Gram-ve					
			Staphylococcus aureus I	*Staphylococcus albus* Woods II	*Bacillus subtilis* III	*Escherichia coli communis* IV	*Salmonella Schotmulleri* V	*Eberthella typhosa* VI	*Shigella dysenteriae* var *Shiga* VII	*Vibrio cholerae* Inaba VIII	*Klebsiella pneumoniae* IX
Ranunculaceae	*Nigella sativa* Linn	(Seeds)	−	+	+	−	−	−	+	−	−
	Clematis Cadmia Ham	(Shoot)	+	+	−	+	+	+	+	+	−
	C gouriana Roxb	,,	+	+	−	+	+	+	+	+	−
	Naravelia zeylanica DC	,,	−	+	−	−	−	−	−		−
Menispermaceae	*Tiliacora racemosa* Colebr	,,	−		−	−	−	−	−	−	−
Papaveraceae	*Argemone mexicana* Linn	(Root)	−	−	−	−	−	−	−	−	−
Capparidaceae	*Cleome viscosa* Linn	(Whole Plant)	−	+	−	−	+	−	+	−	−
	Gynandropsis pentaphylla DC	,,	+	+	−	−	±	−	+	−	−
Portulacaceae	*Portulaca oleracea* Linn	,,	−	−	−	−	−	−	−	−	−
Malvaceae	*Sida rhombifolia* Linn	,,	±	−	−	−	−	−	−	−	−
Malpighiaceae	*Hiptage Madablota* Gaertn	(Root)	±	+	±	+	+	+	+	+	+
Rutaceae	*Glycosmis pentaphylla* Corr	(Whole Plant)	+	+	+	+	+	+	+	+	+
	Murraya exotica Linn	(Leaves)	−	−	−	−	−	−	±	−	−
	Citrus decumana Linn	,,	−	−	−	−	−	−	−	−	−
Meliaceae	*Melia Azadirachta* Linn	,,	−	−	−	−	−	−	−	−	−
Sapindaceae	*Cardiospermum halicacabum* Linn	(Whole Plant)	−	−	−	−	−	−	±	−	−
Leguminosae	*Cassia occidentalis* Linn	,,	−	−	±	+	±	+	−	+	+
	C tora Linn	,,	−	−	−	−	−	−	−	−	−
	C sophera Linn	,,	+	±	+	−	±	−	+	+	−
Passifloreae	*Passiflora foetida* Linn	,,	+	+	+	+	+	+	+	+	+
Rubiaceae	*Oldenlandia paniculata* Linn	,,	−	−	−	−	−	−	±	−	−
	Ixora coccinea Linn	(Root)	−	−	−	−	−	−	−	−	
Compositae	*Centratherum anthelminticum* O Kutz	(Seeds)	−		−	−	−	−	±	−	−
	Vernonia cinerea Less	(Whole Plant)	±	±	±	±	±	±	±	±	±
	Ageratum conyzoides Linn	,,	−	−	−	−	−	+	±	−	−
	Eupatorium odoratum Linn	,,	−	−	−	−	−	−	−	−	−
	Tagetes patula Linn	,,	+	+	+	+	+	+	+	+	±
	Eclipta alba Hassk	,,	−	−	−	−	−	−	−	−	−
	Mikania scandens Willd	,,	−	−	−	−	−	−	−	−	−
Apocynaceae	*Vinca rosea* Linn	,,	±	+	+	+	+	±	+	−	−
Asclepiadaceae	*Calotropis procera* R Br	(Shoot)	+	+	+	+	+	+	+	+	+
Boragineae	*Heliotropium indicum* Linn	(Whole Plant)	+	+	+	−	−	−	−	−	−
Solanaceae	*Solanum nigrum* Linn	,,	±	±	+	−	±	±	+	−	−
Scrophulariaceae	*Herpestis chamaedroides* Linn	,,	−	−	−	−	−	−	−	−	−
	Vandellia crustacea Benth	,,	−	−	−	−	−	−	−	−	−
	Scoparia dulcis Linn	,,	−	−	−	−	−	−	±	−	−
Acanthaceae	*Andrographis paniculata* Nees	,,	+	+	−	−	−	−	±	−	−
	Ruellia tuberosa Linn	,,	+	+	−	−	−	−	−	−	−
Verbenaceae	*Lippia nodiflora* Rich	,,	+	+	+	+	+	+	+	+	+
	Vitex negundo Linn	(Leaves)	−	−	−	−	−	−	±	−	−
Labiateae	*Leonurus sibiricus* Linn	(Whole Plant)	±	±	±	±	±	±	±	±	±
Plantagineae	*Plantago ovata* Forsk	(Seeds)	−	−	−	−	−	−	−	−	−
Nyctagineae	*Boerhaavia repens* Linn	(Whole Plant)	−	−	−	±	+	−	+	−	−
Amarantaceae	*Alternanthera sessilis* R Br	,,	−	−	−	−	−	−	−	−	−
Polygonaceae	*Polygonum orientalis* Linn	,,	−	−	−	−	−	−	−	−	−
	P serrulatum Lagasc	,,	+	+	−	−	+	+	+	−	−
Piperaceae	*Piper nigrum* Linn	(Seeds)	−	−	−	−	−	−	±	−	−
	Peperomia pellucida Kunth	(Whole Plant)	−	−	−	−	−	−	−	−	−
Lauraceae	*Cinnamomum zeylanicum* Breyn Bark	,,	+	+	−	−	±	−	+	+	−
Euphorbiaceae	*Euphorbia thymifolia* Linn	,,	−	−	−	−	−	−	−	−	−
	E pilulifera Linn	,,	+	+	−	+	+	+	+	+	−
	Phyllanthus niruri Linn	,,	−	−	−	−	−	−	−	−	−
	Croton sparsiflorus Morung	,,	+	+	+	+	+	+	+	+	+
	Acalypha indica Linn	,,	−	−	−	−	−	−	−	−	−
Urticaceae	*Fleurya interrupta* Gaud	,,	−	−	−	−	−	−	−	−	−
	Ficus religiosa Linn	,,	−	−	−	−	−	−	−	−	−

+ indicates a complete inhibition on the plant-extra agar side
- indicates no inhibition of bacteria inoculated
± indicates less growth or partial growth.

3 75 mls of sterile double strength nutrient agar (nutrient agar with the various ingredients in twice the normal proportion, *p*H 7 4) at 42°—45°C and made up to 7 5 mls with the addition of sterile distilled water at 42°—45°C Temperature was found to play an imoprtant role as in some cases when the plant extracts were mixed at a higher temperature loss of activity was noticed The whole was poured into the empty half of the petri dish which originally contained an agar bed of 7 5 mls of nutrient agar After cooling and on solidification the plates were dried at 37 5°C with the lids of the petri dishes kept slightly ajar, for 3 hours to obtain agar surfaces dried and freed from the water of condensation

18 hour young growths of the test species on nutrient agar were suspended separately in sterile 1% peptone water to produce a 10 opacity suspension (nephelometry) and streaked across with an L-shaped platinum wire along their respective zones marked as described previously The width of the streaks drawn was approximately 0 5 cm Approximately 0 005 ml per half zone was the amount of inoculum seeded in each case The plates were incubated at 30°—40°C and were observed after 24 hours The results of the experiment are presented in the Table

Discussion —It is evident from the Table that the majority of the plants showed negative results whereas 11 out of the total lot have shown complete inhibition of many or all the species seeded They are as follows

Passiflora foetida	*Glycosmis pentaphylla*
Clematis Cadmia	*Clematis gouriana*
Cinnamomum zeylanicum	*Calotropis procera*
Tagetes patula	*Lippia nodiflora*
Euphorbia pilulifera	*Hiptage Madablota*
Croton sparsiflorus	

A few others have also shown partial inhibition of many of the test species and in a few cases gram-sensitiveness of the inhibitors were noticed *Shigella dysenteriae* var *Shiga* was usually the most susceptible of the organisms tested as in many cases it was alone completely inhibited The colonies of the contaminants from the plant material which appeared in many of the plates did not, however obscure the readings of the results The advantages of the modified method are (*i*) the control and the experiment under the same conditions of inoculation and incubation can be compared side by side, (*ii*) antibacterials which are non-diffusible can be tested and (*iii*) non-sterile extracts can be studied

SUMMARY

57 species of plants belonging to 32 families are collected locally and tested against 9 different species of gram-positive and gram-negative micro-organisms and the results tabulated

11 species of plants show complete inhibition of growth of many or all the organisms seeded and a few others exhibit partial inhibition, the remaining giving negative results *

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* The authors wish to express their sincere thanks to Dr U P Basu for his suggestions and keen interest throughout the course of this investigation

SOME POTAMOLOGICAL ASPECTS OF THE RIVER HOOGHLY IN RELATION TO CALCUTTA WATER SUPPLY*

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THE Metropolitan town of Calcutta with a normal population of 2,018,891 (1941 census) is situated on the bank of the Hooghly which is the estuary of three different rivers, *viz* the Bhagirathi, Jalangi and Mathabhanga. The rivers joining the Bhagirathi from the east and the west carry down huge amounts of sand and silt during the rainy season, and the so-called red water appears in the Hooghly carrying with it all the wash-water of Santal Parganas and Chotanagpur. The flood and ebb-tides play with these silts and sands twice every day thus making it difficult for these to come out of the river bed—consequently, the bed of the river gradually rises with their deposit (Bose)[2]. The filtered water supply of Calcutta is made from Palta Pumping Station situated at a distance of about fourteen miles up the proper city of Calcutta, on the bank of the Hooghly. The Hooghly water is pumped into the settling tanks where it is settled for about 48 hours and then filtered through the sand filter beds by the slow sand filtration method. It has been observed that every year during the summer months and also to a less extent during the winter months there is a tendency towards a reduction in the filtered water supply due to some factors hampering with the normal working of the filter beds at Palta.

Preliminary investigations reveal that excessive algal growth is responsible for this trouble. The large filamentous growth seems to have no concern with this trouble. With a view to find out if the plankton organisms in the river water have got any direct influence on the working of the filter beds, the author has made a qualitative as well as a quantitative study of the river water plankton together with a study of their ecology and seasonal and annual variations, over a period of three years from July, 1945 to June, 1948. These findings may well represent a good length of the river, as the longitudinal variations of the environment are commonly not found in short stretches and the samples are collected off the shore.

The quantitative estimation is done according to the following procedure. The sampling is done daily in the morning in "a one-litre bottle" off the shore wherefrom the water is pumped into the settling tanks. The sampling bottle containing the water is shaked well very gently, one drop of the water is taken on a glass slide from a 1 c c pipette and very lightly covered with a cover glass so that the whole system forms a square-block as it were. This block is examined under the microscope diametrically across the centre for two paths at right angles to each other. The organisms in these two paths are counted in terms of areal standard units of Whipple[11] (1 areal standard unit = 400 sq μ). The count thus obtained is multiplied by the product of the number of drops delivered by the 1 c c pipette and the ratio of the diameter of the cover glass to twice the diameter of the field of view of the microscope, to have the approximate standard units per c c. The method is a simple modification of that of Lackey,[7] in that the samples are not centrifuged before quantitative examination.

The identifications are done with the help of standard keys up to 'genus' only (Fritsch,[6] Whipple,[11] Ward and Whipple[10]). The unidentified genera are taken into consideration in group treatments alone. All the unidentified flagellates and ciliates are included under the group 'Protozoa'. The 'Myxophyceae' and 'Schizomycetes' have been considered together under the group 'Schizophyta' (of Engler). In the determination of annual yields, the months from July of one year to June of the next stand for one complete year. The chemical analyses of the samples are done according to standard methods of water analysis.

The plankton flora is found to be composed of only 46 genera, of which 38 belong to algae, 4 to Protozoa and Rotifera and 4 to Schizomycetes, *i e*, higher bacteria. These are

I *Algae (classified according to Fritsch)*

Isokontae (Chlorophyceae)—Pediastrum, Micractinium, Tetraedron, Ankistrodesmus, Actinastrum, Crucigenia, Scenedesmus, Geminella, Penium, Closterium, Cosmarium

Bacillariales (Diatomaceae)—Melosira, Cyclotella, Stephanodiscus, Coscinodiscus, Fragillaria, Synedra, Navicula, Stauroneis, Pleurosigma, Gomphonema, Cymbella, Encyonema, Rhopalodia, Bacillaria, Nitzschia, Surirella

Peridineae (Dinophyceae)—Glenodinium and *Peridinium*

Eugleninea—Euglena, Phacus, Trachelomonas and *Ascoglena*

* This article is based on the Paper read at the Indian Science Congress, 1949 (*Proc 36th I S C Part III*, Abstracts, p 147)

Myxophyceae—Oscillatoria, Phormidium, Lyngbia, Anabaena, Aphanizomenon

II *Protozoa (classified according to Calkin)*
Sarcodina—Difflugia
Mastigophora—Monas
Infusoria—Codonella

III *Rotifera (classified according to Hudson and Gosse)*
Bdelloida—Rotifer

IV *Schizomycetes or Higher Bacteria*
Chlamydobacteriales or *iron bacteria—Leptothrix, Didymohelix* and *Crenothrix*
Thiobacteriales or *sulphur bacteria—Beggiatoa*

The Crustacea are sometimes recorded and the higher Crustacea, *i e*, the crab, is found to occur during less plankton growth, but no attempt is here made for their quantitative and other studies

The quantitative findings of this study are summarised in the following condensed tables where the

TABLE I

AVERAGE ANNUAL YIELD IN AREAL STANDARD UNITS PER C C OF 'PHYTOPLANKTON' AND 'ZOOPLANKTON' ALSO EXPRESSED AS PERCENTAGE OF THAT OF TOTAL PLANKTON

Year	Average Total Plankton S U /c c	Average Phytoplankton		Average Zooplankton	
		S U /c c	% of T P	S U /c c	% of T P
1945 46	710	653	92	57	8
1946 47	169	142	84	27	16
1947-48	259	215	83	44	17

yearly averages only of the yield of the different plankton organisms have been taken into consideration The yearly averages have been obtained from the monthly averages which in their turn have been

TABLE II

AVERAGE ANNUAL YIELDS IN AREAL STANDARD UNITS PER C C OF 'DIATOMS', SCHIZOPHYTA AND CHLOROPHYCEAE', ALSO EXPRESSED AS PER CENT OF THAT OF 'PHYTOPLANKTON' AS A WHOLE

Year	Average Phyto plankton yield S U /c c	Average Diatom yield		Average Schizophyta yield		Average Chlorophyceae yield	
		S U /c c	% of P P	S U /c c	% of P P	S U /c c	% of P P
1945-46	653	335	51	182	28	108	17
1946-47	142	96	68	26	18	5	4
1947-48	215	161	75	42	19	7	3

calculated from the average weekly yield, the weekly average yield being the mean of the daily readings. The daily readings represent the mean of five different countings done with five drops of water separately

From the above Table I it is found that the 'Phytoplankton' plays the main role in determining the annual variations in the yield of the 'Total Plankton' This is also evident from Fig 1

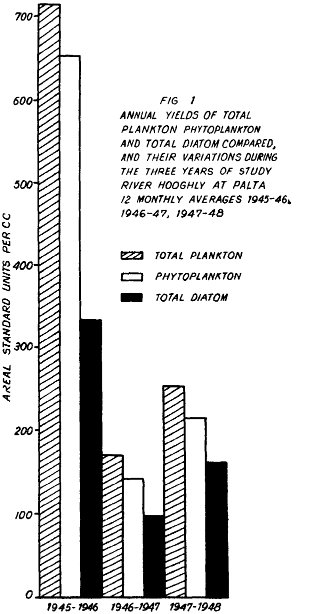


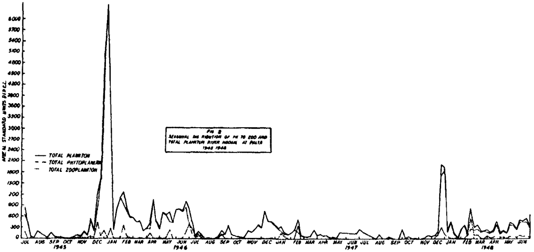
FIG 1 ANNUAL YIELDS OF TOTAL PLANKTON PHYTOPLANKTON AND TOTAL DIATOM COMPARED, AND THEIR VARIATIONS DURING THE THREE YEARS OF STUDY RIVER HOOGHLY AT PALTA 12 MONTHLY AVERAGES 1945-46, 1946-47, 1947-48

Fig 2 will show this to be the fact with regard to the seasonal variations of the 'Total plankton' also

A comparison of fig 3 with fig 2 and an examination of table II above will show that the 'Diatoms' play the most important part in the execution of the cycle of seasonal as well as annual variations of the 'Phytoplankton' This is also the observation

of Damann[3] in his study of the Lake Michigan Plankton This will be self-evident from fig 1 also

The maximum yield of the 'Diatoms' as also of the total 'Phytoplankton' is recorded during the winter months, as will be seen from figs 2 and 3, wave of the yield of the 'Diatoms' during the winter is not due to the same genus every year From Table III *Melosira* is found to be the most dominant diatom during the years 1945-46 and 1946-47, representing 52 and 20 per cent respectively of the



in all the years of study The winter pulse starts just with the close of fall and is continuous with the least significant spring pulse which terminates not later than June or July Damann[3] had also got similar readings with diatoms such as *Fragillaria*, *Tabellaria*, etc Although 'Chlorophyceae' was predominant and not the diatoms, Purdy[10] in his study on the Illinois River, however, has mentioned of the maximum Phytoplankton-yield during the spring or summer It should be noted that the temperature of the Illinois River during the spring or summer more or less approaches the winter temperature of River Hooghly

average annual yield of 'Total Diatoms' Damann[3] in his study of Lake Michigan Plankton found this to be a seasonal dominant producing only above 2 per cent of average 'Total Plankton' The high annual yield of *Melosira* as found by the author is due to its huge yield during the period of dominancy as will be seen from fig 3 In the third year, however, the yield of *Melosira* is almost insignificant compared to that of the previous years, when *Coscinodiscus* takes up the dominant phase producing 74 per cent of the 'Total Diatoms' This loss or gain of annual dominancy may be due to the natural cycle of annual variations of the different

TABLE III

\VERACE ANNUAL YIELDS IN ARFAL STANDARD UNITS PER C C OF THE DIFFIRENT DIATOM GENERA, ALSO EXPRESSED AS PERCENTACE OF THAT OF TOTAL 'DIATOMS'

Year	Av Total Diatoms S U /c c	*Melosira* (av)		*Coscinodiscus* (av)		*Nitzschia* (av)		*Synedra* (av)		*Navicula* (av)		Rest (av)	
		S U /c c	%T D	S U /c c	%T D	S U /c c	%T D	S U /c c	%T D	S U /c c	%T D	S U /c c	%T D
1945 46	335	174	52	59	18	28	8	20	6	29	9	25	7
1946 47	96	19	20	11	11	31	32	5	5	5	5	25	26
1947 48	161	8	5	119	74	18	11	1	1	2	1	13	8

Table III above shows that the same genus of diatom has not got similar yields during the different years of study and that all the genera are not equally responsible for the annual variations in the yield of the 'Diatoms' This is evident from fig 4 as well Also, it is distinctly seen from fig 3 that the pulse-clankton organisms which can only be ascertained by collecting data for some future years , or it may be due to the changing hydrographic conditions Damann[3] found a recurring two-year cycle of the 'Total Plankton' yield of Lake Michigan on studying the data collected over a period of 16 years from

1926 to 1942 It will be seen from fig 5 and Table III that the 'Rest Diatoms' consisting of *Cyclotella, Stephanodiscus, Fragillaria, Stauroneis, Pleurosigma, Gomphonema, Cymbella, Encyonema,*

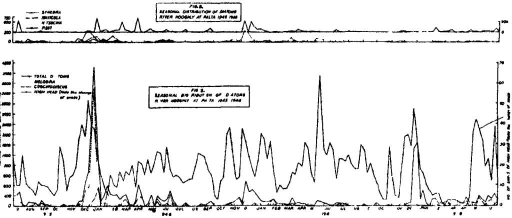
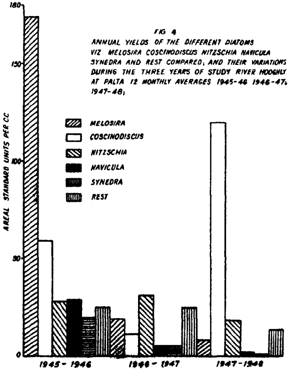


TABLE IV

AVERAGE ANNUAL YIELDS IN AREAL STANDARD UNITS PER C.C. OF THE DIFFERENT GROUPS OF PHYTO- AND ZOOPLANKTON ALSO EXPRESSED AS PER CENT OF THAT OF TOTAL PLANKTON

Year	Av Total Plankton S U /c c	Av Chlorophyceae		Av Diatoms (Bacillariales)		Av Peridinacae (Dinophyceae)		Av Euglenineae		Av Schizophyta		Av Protozoa	
		S U /c c	% T P	S U /c c	% T P	S U /c c	% T P	S U /c c	% T P	S U /c c	% T P	S U /c c	% T P
1945 46	710	108	15	335	47	12	2	16	2	182	26	54	8
1946 47	169	5	3	96	57	4	2	11	6	26	16	26	15
1947 48	259	7	3	161	63	3	1	2	1	42	17	38	15



Rhopalodia, Bacillaria and *Surirella* have as a group at least some influence in determining the seasonal and annual variations of the 'Total Diatoms', though negligible in yield for being considered separately Damann[1] found the 'Rest Diatoms', behaving in a similar way, though his grouping was not done with the same genera

The two genera *Oscillatoria* and *Beggiatoa*, of the *Schizophyta* together appear to have a similar annual trend of yield during the different years of study, while the other two *Anabaena* and *Leptothrix* show their annual trends varying from year to year

An examination of Table IV above will indicate comparatively the annual dominancy of the different groups of Phyto- and Zoo-Plankton, relative to the average annual yield of the 'Total Plankton' From this as well as from the above tables, the 'Diatoms' are found to occupy the first place as regards yield in all the three years of study The *Protozoa* is found to come third in order of dominancy in both the years 1946-47, and 1947-48 for a yield only, and 2 per cent less respectively to that of the '*Schizophyta*' if, however, the flagellates 'Dinophyceae & Euglenineae' are considered under the group 'Protozoa', this group holds the second position as

observed by Damann[3]. The relative dominancy of the other groups is varying from year to year.

Plankton production seems to have no direct relationship with the turbidity, though the highest yield is obtained during the lowest turbidity period, as also found by Damann[4]. The turbidity, however, seems indirectly to be related with the plankton yield in as much that it controls the sunlight available for the development of the heliophilous organisms. The 'Total Plankton' or 'Phytoplankton'-yield of the river water is found to be much reduced during the monsoon.

TABLE V

AVERAGE ANNUAL YIELD OF THE PLANKTON IN S.U./C.C. AND TOTAL ANNUAL RAIN FALL IN INCHES

Years	Av. annual yield of the 'Plankton' (S.U./c.c.)	Total rain fall in inches
1945-46	710	33.98
1946-47	169	52.7
1947-48	259	50.05

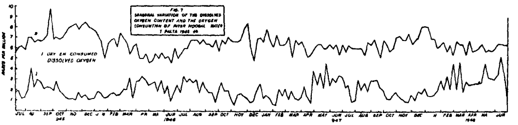
From Table V above, the total annual rainfall is seen to have a distinct reverse relation with the average annual yield of the 'plankton'. This reverse relation will also be found to hold good in case of the seasonal yield of the 'Plankton' on comparing fig. 2 with fig. 6. The actual reason for this reduced Plankton yield and reverse relation is not clear, but amongst other factors such as current and quality of the water, beating of the raindrops, etc., the increasing dilution of the Plankton-loaded water with the increasing rainfall and the wash-water of the Chotanagpur, Santal Parganas, etc., brought during the monsoon period may be held chiefly responsible for this. Kofoid[8] reported the action of the December, 1895, flood on the Illinois River as follows: "Rising suddenly from low levels (3 ft.) to overflow stage (12.6 ft.) in 12 days, it depleted the channel plankton from 2.6 c.c. per cubic meter in the initial stages to 0.08 on the 25th, if not, indeed earlier."

TABLE VI

AVERAGE ANNUAL YIELD OF DIATOMS IN STANDARD UNITS PER C.C., ALSO EXPRESSED AS PER CENT OF TOTAL PHYTOPLANKTON AND AVERAGE ANNUAL SALINITY OF THE RIVER WATER

Years	Av. yield of Diatoms S.U./c.c.	Av. Diatom yield as per cent of Total Phytoplankton yield	Av. salinity
1945-46	335	51	15
1946-47	96	68	23
1947-48	161	75	26

From Table VI above, it is seen that the yearly average of salinity of the river water shows an increasing tendency over the 3 years' period of study. It is also seen from the same Table that there is a regular increase every year in the average annual yield of the diatoms expressed as percentage of that of the 'Phytoplankton', though the average annual yield of Diatoms in areal standard units per c.c. does not follow the same sequence. This indicates that the 'Phytoplankton' becomes more and more represented by the diatoms (sea-water organisms) as the successive years pass on and also as the water becomes more and more saline, the Hooghly water thus approaching the characteristic of the sea-water. One of the reasons of this may be the gradual rising of the river bed resulting in lesser and lesser influence of the monsoon-water in bringing about the dilution of the water brought by the sea. It will be seen from a comparison of figs. 2 and 7 that the river water has got the highest dissolved-oxygen content and lowest oxygen consumption during the winter,



the period of maximum 'Phytoplankton' yield This goes quite parallel with the theory that more Phytoplankton growth sets free more oxygen by photosynthesis than it consumes by respiration, resulting in an ultimate increase of the dissolved—oxygen content, as this does not appear to be singly due to the fall in the water temperature Thus on comparing the dissolved oxygen content with the temperature of the river water during December and January, 1945 it is found that the dissolved oxygen content instead of increasing decreases with the decreasing water temperature This is also evident during the succeeding years Also though the dissolved oxygen content of the river water never reaches its saturation point except on the 3rd week of September, 1945 when it is far above the saturation point, it is near about 8 parts per million during the whole of December 1945 and first part of January 1946, when the phytoplankton yield is also very high and again reaches 8 parts per million during the last two weeks of high phytoplankton-yield of December 1947 , but it never reaches the limit of even 7 parts per million during the winter of 1946-47 when the pulse of phytoplankton-yield is almost insignificant compared to the corresponding pulses of the preceding and succeeding years The dissolved oxygen figures of the 3rd week of September 1945 showing a value far above the saturation point, cannot however be explained in the light of photosynthetic activities as the phytoplankton-yield during this period is not considerable compared to that during the winter A record of high wind on this occasion may be advanced as an explanation of this high figure, but this does not seem to be sufficient reason for this high figure This may however be due to errors during collection and examination of the sample

A very strict quantitative relationship cannot however be traced between the phytoplankton-yield and dissolved oxygen content This may be due to some limitations imposed upon the photosynthetic activities or upon the availability during sampling of the gaseous products of photosynthesis by the changing environmental and hydrographic conditions of the river Again as the samples are collected early in the morning, the convection current set up at night due to the cooling of the surface water may bring about wide differences in the dissolved oxygen figures even when there is a huge growth of algae Also decomposition and respiration going on at night may be responsible for this difference

The winter-low content of nitrate and albuminoid ammonia in the river water may be explained as due to a rapid consumption of these by the huge plankton growth That the plankton-yield begins to increase with the increase of hardness of the water may be explained as due to the stimulus obtained from a greater amount of free carbon dioxide accompanying the water of high hardness The alkalinity of the water is determined with methyl orange as indicator and the hydroxide alkalinity is found to be nil or almost negligible during the whole period of study and so the alkalinity is almost entirely due to carbonates and bi-carbonates The total hardness is found not to be much greater than the alkalinity and some times it is found to be even less So the non-carbonate hardness appears to be very little and this carbonate and bi-carbonate alkalinity appears to be the reason also of the increase in the yield of phytoplankton when the alkalinity is tending to rise

The optimum temperature for the growth of the diatoms seems to be near about 20°C This temperature more or less approaches the limit observed by Damann, namely 60°F But the maximum temperature for the growth of diatoms such as *Nitzschia, Synedra,* etc , as observed by the author is far above this limit of Damann The rest of the diatoms as a group appear, unlike Damann's observations, not to be conditioned in their yield by the water temperature Similar is the case with Protozoa The actual genera included in this group by the author and Damann respectively, may have some bearings on their respective findings Also it should be noted that the hydrographic conditions of river are more flexible than those of a lake The growth of Chlorophyceae appears not to be favourable at or above 25°C, in conformity with the observation of Damann that the Chlorophyceae does not grow at or above 60°F On comparing Fig 5 with Fig 6, the water temperature, when considered singly, appears to be the most important factor in determining the seasonal periodicity of the plankton as observed by Damann Kofoid also came to the same conclusion in a five years' study of the Illinois river

From the data at hand it is concluded that the growth of diatoms in river water may be directly responsible for the chokage of the filter beds during the winter From Fig 3, a quantitative relationship in some form or other seems to exist between the pulse of Diatom-yield of the river water and High Head of the filter beds indicating the proportion of chokage, during the winter The Diatoms occurring in the river water are also recorded from the water in settling tanks almost in similar strengths They are also recorded from the sand collected from the filter beds with or without some other organisms But the chokage during the summer appears to be due to some growths, intrinsic to the settling tanks and filter beds of diatoms such as *Synedra, Nitzschia,* etc , either independently or in collaboration with some thread-like organisms such as *Oscillatoria* (steel—blue in colour), *Beggiatoa, Leptothrix,* etc The diatoms mainly responsible for the winter chokage appear

to be *Melosira* and *Coscinodiscus* (figs 8 and 9) belonging to the *Centricae'* with or without some other organisms A 'blocking' effect due to the diatoms of '*Centricae* group is also reported by

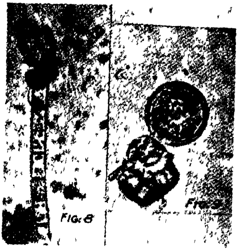


Fig 8 Chain of *Melosira varians* Ag with auxospore ×300 (approx)
Fig 9 *Coscinodiscus* sp ×700 (approx)

Houston He also reports the difference in the growth of plankton in the raw and stored water, the reservoirs harbouring growth of one or another kind irrespective apparently of the water pumped into them *

* The author wishes to express his deep sense of gratitude to Dr M U Ahmed, Health Officer and Dr S K Ghosh, Chief Analyst Calcutta Corporation, for the encouragements and facilities given to him during this study and also to Sri C D Bose for his helpful assistance in course of the chemical analysis of the samples

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Notes and News

INDIAN SCIENCE CONGRESS

THE Thirty-sixth Session of the Indian Science Congress was inaugurated on Monday, January 3, 1949 by the Hon'ble Pandit Jawaharlal Nehru, Prime Minister and Minister for Scientific Research, Government of India at the Allahabad University

Her Excellency Srimati Sarojini Naidu, Governor of the United Provinces and Chancellor of the Allahabad University welcomed the members and delegates who had come to attend the Session She said that they were all men of science who had dedicated themselves to the cause of salvation of humanity from destruction Today the world was in such a condition that men lived in fear of one another Fear brought destruction, fear brought hatred and created mightmindishness and fear was the ultimate destroyer of the world But if men of science resolved for the good of humanity how marvellous the world would be! She was confident that the scientists who had gathered there were a brilliant galaxy of men and they would serve the right cause To talk of freedom was mockery and sinister if it was not realised that every human being had a right to salvation said Srimati Naidu

Requesting Pandit Nehru to inaugurate the Congress, Srimati Naidu said that they had found in him a man who had sacrificed his all for the national freedom and also for the cause of international co-operation He had become their inspiration and guide

Inaugurating the Session Pandit Nehru said that one thing which was greatly agitating his mind was the present condition of the world It was definitely in a bad way and as scientists it became their duty to analyse the causes of this rot

"I think that with the advancement of science the balance of the human mind has not advanced We still live in different grooves and think with a narrow outlook The result is that the poise of the world is disturbed, putting it in a bad way I feel it is the duty of scientists to see that along with the advancement of science this balance or poise of mind also advances I do not ask you to go back, for going back means fading away There should certainly be an attempt to preserve everything we have got and to add to it, but there should also be, side by side, an attempt to balance it This balancing should be done in all spheres, economic, political and even in the spirit of mankind

"The conflict of spirit which has been generated due to this disturbance of the balance affects all and, as scientists, it becomes your duty to ponder over it and solve it and bring back the lost balance"

Pandit Nehru said that they were living in a period when most people talked about science, praised science and its achievements and thought in terms of science Undoubtedly science had done tremendous work Undoubtedly they had to concentrate on advancing scientific research and its application He realized that every country must do its utmost in respect of scientific research and its application They realized that they could not solve their problems without the help of science

Science must progress, and they as a Government would certainly provide all the opportunities for the progress of science But what really counted was not the money and the institutes and the opportunities that flowed from the Government but human beings of the right calibre He believed that many young men in the scientific field were of the right calibre and they were bound to make good progress if they were given good opportunities

Pandit Nehru laid stress on quality rather than quantity of work in the scientific field He thought they were not yet as big in the scientific field as India ought to be They were lost in the smaller things—in mutual debates and arguments and did not concentrate on real scientific work He would therefore like to see fundamental work rather than superficial work and a spirit of true science inspire them and lead them to bigger achievements

Sir K S Krishnan, General President of the Congress, addressing the delegates announced that the Government of India was setting up an Atomic Energy Commission under the chairmanship of the Prime Minister, Pandit Jawaharlal Nehru He said the development of atomic energy had become of great topical interest and it was fitting that in the research of this energy India will not lag behind other countries

The President also announced that the Government of India were shortly going to establish an Institute of Scientific Research and wanted Dr Sir C V Raman's services on the Institute He felt happy on the offer and hoped that under Sir C V Raman the Institute will be of real utility and importance to the country

NATIONAL INSTITUTE OF SCIENCES OF INDIA

PRESIDING over the annual meeting of the National Institute of Sciences of India on January 4, 1949, Dr S S Bhatnagar emphasised the need for an "even and constant flow of scientific workers and leaders imbued with the zeal and zest for research in India "

Dr Bhatnagar said that there should be sufficient financial and material resources appropriate to each stage of development and stressed the necessity for bold and flexible thinking in framing the policy of the Universities

He added, "While industrial research is the prime necessity for development, a vigorous pursuit of fundamental research is vital, being the source from which extraordinary applications are likely to emerge It is necessary for young men to follow in the wake of great scientists and blaze the path of the better world of to-morrow "

Dr Bhatnagar surveyed the work of the National Institute of Sciences and of the scientific activities in the country including the formation of the Department of Scientific Research, the creation of the post of Scientific Adviser to the Ministry of Defence, and the importance of co-ordination for organised team work, avoidance of duplication and planning of new scientific projects

Dealing with the Department of Scientific Research created in June last year under the direct control of the Prime Minister Pandit Nehru, Sir Shanti Swarup said that during the short time the Department had been in existence it had paid out grants to learned societies and research institutes totalling over rupees 14 lakhs and it was expected that further grants amounting to about Rs 8 lakhs would be made before the financial year closed

Continuing he said, "the development of science and industry in this country will need a large potential scientific man-power While National Laboratories and research institutes will play an ever-increasing part in furthering the application of science to industry, it is clear that ultimately we have to depend upon the Universities for an even and constant flow of scientific workers and leaders imbued with zeal and zest for research The fast changing world conditions and the new role of science necessitate a vital change in the outlook of the Universities and the Government

"Universities have been rightly regarded as the fountain-head of knowledge and it is in their free atmosphere that we should look forward to vigorous pursuit of fundamental research Fundamental research is the source from which extraordinary applications are likely to emerge and unless we keep ourselves in the forefront of fundamental work, it is unlikely that we would make much original contribution to applied research I would make a special appeal to our Universities, our research institutes and our learned societies not to slacken their support for fundamental research "

In conclusion, Dr Bhatnagar, referred to the 'Science Club' organisation of U S A which serve as a recruiting ground for scientists of exceptional ability The Clubs are administered by a Science Service which conducts annually a Science Talent search through which promising boys and girls are selected for further training He suggested that we might follow the experience of U S A and start "Science Clubs" and help solving India's shortage of scientific manpower

THE following were elected Office bearers and Members of its Council for the year 1949 *President* —Prof S N Bose (Calcutta), *Vice-Presidents*—Prof A C Banerji (Allahabad), Maj Gen Sir S S Sokhey (Bombay), *Treasurer*—Dr C G Pandit (Delhi), *Foreign Secretary*—Dr J N Mukherjee (Delhi), *Secretaries*—Prof D S Kothari (Delhi), Dr H S Pruthi (Delhi), *Editor of Publications*—Dr S L Hora (Calcutta), *Members of Council*—Dr K N Bagchi (Calcutta), Dr S K Banerji (Delhi), Mr S Basu (Poona), Prof H J Bhabha (Bombay), Prof S R Bose (Calcutta), Dr B B Dey (Madras), Prof A C Joshi (Hoshiarpur), Dr S Krishna (Dehra Dun), Sir K S Krishnan (Delhi), Prof S K Mitra (Calcutta), Dr B Mukerji (Calcutta), Mr G R Paranjpe (Poona), Dr M Prasad (Bombay), Mr J M Sen (Calcutta), Dr A C Ukil (Calcutta)

The following distinguished foreign scientists were elected Honorary Fellows of the Institute

- Prof Louis de Broglie, Professor of Theoretical Physics, Poincare Institute, Sorbonne, Paris
- Prof Hans von Euler, Emeritus Professor of Chemistry, Stockholm University, Stockholm
- Dr Harlow Shapley, Director of Harvard Observatory and President of the American Association for the Advancement of Science
- Prof Georg Tischler, Botanical Institute, Kiel University, Germany

The following were elected Ordinary Fellows of the Institute Dr J L Bhaduri, Lecturer in Zoology, Calcutta University, Dr S Bhagavantam, Scientific Liaison Officer for India in the United Kingdom, Dr S K Chakrabarty, Director, Colaba and Alibag Observatories, Bombay, Dr D Chakravarti, Lecturer in Chemistry, Calcutta University, Dr M Damodaran, Assistant Director, National Chemical Laboratories, Delhi, Dr B K Das, Professor and Head of the Department of Zoology, Osmania University, Hyderabad-Deccan, Dr K Jacob, Palaeobotanist, Geological

Survey of India, Calcutta, Dr T S Mahabale, Lecturer in Botany, Royal Institute of Science, Bombay, Dr H K Mitra, Refractories Engineer, Tata Iron and Steel Co, Ltd, Jamshedpur, Dr K Mitra, Officer-in-charge, Nutrition Scheme, Public Health Laboratories, Bihar, Patna, Dr A H Pandya, Director, Hindusthan Aircraft, Bangalore, Dr N Parthasarathy, Geneticist, Indian Agricultural Research Institute, New Delhi, Dr C Racine, Professor and Head of the Department of Mathematics, Layola College, Madras, Dr K C Sen, Director, Indian Dairy Research Institute, Bangalore, Dr R S Varma, Reader in Mathematics, Lucknow University, Lucknow

Awards of following Research Fellowships were made to

Imperial Chemical Industries (India) Research Fellowship

Dr S N Ghosh (Physics), Calcutta University, Calcutta

Dr L R Row (Chemistry), Andhra University, Waltair

National Institute of Sciences Senior Research Fellowship

Dr A P Kapur (Zoology), Zoological Survey of India, Calcutta

SILVER JUBILEE OF THE INDIAN CHEMICAL SOCIETY

THE Silver Jubilee Celebration of the Indian Chemical Society was held at Allahabad during the Science Congress week in January, 1949, when Professor P Rây, President of the Society presented the Silver Jubilee brochure to the members The Society was registered on May 9, 1924 with Sir P C Ray, leader of the Indian School of Chemists, as its Founder-President The *Journal of the Indian Chemical Society,* which was first published in November, 1924 and subsequently appeared as a quarterly journal for the first four years, was changed into a bi-monthly one in 1928 and into a monthly journal since 1930 Since 1937, in collaboration with the Institution of Chemists (India) an Industrial and News Edition of the journal has been published separately as a quarterly periodical

In the presidential address presented to the meeting, Prof Rây recalled that the aims and objects of the Society are primarily to encourage and foster the spirit of enquiry and original research through exchange of ideas and information between workers in the same field all over the world, to protect and develop the scientific life in our own country so far as the study of Chemistry is concerned and to promote the growth of a cultural fellowship among the chemists in general He referred to the Silver Jubilee brochure that contained a short history of the research in Chemistry in India up to the present time, and deplored the standard of publications which has not been of the order that might inspire confidence in a better or brighter future The dearth of qualified and properly trained teachers and investigators can be attributed not only to unattractive emoluments but mainly to the simple reason that the basic scientific training in schools, and colleges is far below the standard aimed at, and that the post graduate classes of the university are usually ill-equipped for an advanced course of study, to be followed by a training in research work It is a happy news that the Central Government has realized the importance of science for the national planning and reconstruction, and is ready to help the universities with financial assistance for a regular supply of trained personnel and research workers Regarding the relative importance of fundamental knowledge and its practical application, about which there is great misconception among the members of the public as well as the scientists, Prof Rây emphasized on the harmonious and orderly development of the two in their proper relationship, giving more importance to pure science that promotes freedom of original thinking which would help in the planning for national development

Speaking on the subject of internatonal control of Atomic Energy, Prof Rây pointed out that scientists of the world should organize themselves into an International Federation, every member of which should pledge himself that he will completely non-co-operate with all activities connected with preparation of war About the problem of the medium of instruction and expression for science in free India to day, Prof Rây believed that India has already acquired an international reputation in the scientific world and she can ill-afford to make any rash experiment with her system of education, which may retard the activities of her scientific workers

The following office-bearers were duly elected for the year 1949 *President*—Dr J N Ray, *Hony Secretary*—Dr D Chakravarti, *Hony Treasurer*—Dr J K Chowdhury

THE SIXTIETH BIRTHDAY OF SIR C V RAMAN

AFTER ten years that have elapsed since the publication by the Academy of the Jubilee Volume on the occasion of Sir C V Raman's fiftieth birthday, the Academy has published a Symposium on Crystal Physics in commemoration of his Sixtieth Birthday on the 7th November, 1948 The total

number of papers, published during 1918 to 1948 by Raman and his pupils on crystal physics are 328. The investigations of Raman on optics and crystal physics are linked together. In the latter part of 1921, Raman's investigations on the diffusion of light in transparent media led to the discovery of the phenomenon of the *thermal diffusion of light in crystals*. Apart from the discovery of the Raman Effect, the studies on the scattering of light in gases and liquids carried on during 1921-27, opened up new pathways of research on birefringence and pleochroism in crystals. Raman's discovery of 1928 opened up a vast new field of activity in the investigations of complicated molecules in solutions and of crystalline state of matter. Raman Spectra of diamond and other numerous crystals have revealed interesting results of far reaching importance (see SCIENCE AND CULTURE, December, 1946, p. 267). A fundamental question in the theory of the solid state is the nature of the vibration spectrum of a crystal. Raman's idea is that since we are concerned with the vibrations of a mechanical system, we have necessarily to consider its "normal modes". These modes are different for the "elastic" vibrations in a continuum and the "atomic" vibrations in a discrete structure. In the former case the vibrational modes and frequencies are determined by the external boundary conditions, while in the latter case, the external boundary conditions are wholly irrelevant. From these ideas Raman derived his fundamental proposition on the structure of crystal which explains in a completely quantitative fashion all experimental results. In 1943 Raman formulated a new theory of lattice dynamics. The new theory leads to the most important result that the vibration spectrum of a crystal consists essentially of a finite number of discrete frequencies.

The investigation of the physical behaviour of diamond has of recent years formed one of the principal activities of Raman's laboratory. It is recognised that the electronic structure of diamond may possess either tetrahedral or octahedral symmetry. There are two sub-species (positive and negative, respectively) of the tetrahedral type and two sub-species of the octahedral type. The recognition of the existence of these four species of the diamond structure appearing separately or together in any actual specimen of diamond enables the varied behaviours actually met with to be satisfactorily described and interpreted. The luminescence and absorption spectra of diamond and also the infra red absorption spectra have been studied with great thoroughness with results of exceptional interest. The effect of temperature on the optical properties of diamond and other crystals, and the thermal properties of crystals have been thoroughly studied in recent years.

The symposium consists of twenty-nine papers dealing with various aspects of the subject of Crystal Physics. (See *Proc Ind Acad Sci*, 28, November, 1948)

MEASUREMENT OF RADIOACTIVE ISOTOPES

THE U. S. National Bureau of Standards has issued standard samples of radioisotopes whose radioactivity has been accurately determined, and is planning to issue samples of additional radioisotopes as they become available. Essentially the measurement of a sample of radioisotope is the measurement of the number of radioactive atoms present. This is dependent on the rate of disintegration, that is, the number of nuclear particles which are emitted in unit time from all atoms disintegrating within this interval of time. Counting the total number of disintegration particles is not a simple procedure. The principal difficulty arises from the fact that these particles are emitted equally in all directions. It is practically impossible to devise detecting equipment that will record all of them. Most of the difficulties in making quantitative determinations of radioisotopes can be eliminated if standard sources of the isotope are available.

A standard source consists of a preparation of the isotope in a form convenient for use with the detector of radiation, and for which the disintegration rate is known from previous calibration. When the isotope to be measured is the same as that from which the standard is prepared, reliable results may be secured. Other isotopes which have short half periods and a known disintegration scheme may also be measured with fair accuracy by means of beta ray standards if it is known that a beta ray or a position is emitted for every disintegration, and if the maximum energies of the beta-ray spectra of the standard and of the specimen are not too widely different.

In the case of those isotopes for which a disintegration scheme is lacking, or for which the mode of disintegration does not permit measurement of disintegration rates, an alternative method of comparing the activities of sources is available if the isotope emits gamma rays. This method does not give disintegration rates, but yield reliable comparisons of sources in various laboratories. It is limited to comparisons of the same isotope. To secure reliable results, a standard instrument and standard geometry are necessary. The roentgen is a convenient unit of gamma radiation, which is defined without reference to the energy of the gamma ray. An ionization instrument properly designed to measure roentgens will satisfy the requirements for a standard instrument. To determine the strength of a radioactive

source the roentgens per unit time must be measured at a standard distance Bureau scientists have proposed that the unit of time be one hour and the distance one meter, giving as a unit for comparison of gamma-ray sources the *roentgen per hour at a meter (rhm)*

At the same time the name *rutherford (rd)* has been proposed for that quantity of radioisotope which disintegrates at the rate of a million disintegrations per second The use of the *rutherford* in data presupposes that a disintegration rate has been measured and that this rate is expressed in disintegrations per second (*Journal of the Franklin Institute*, November, 1948)

INDIA TO MANUFACTURE NEWSPRINT

A newsprint factory for producing 30,000 tons annually will be built in India this year, and production will start by the end of 1949 This will be India's first newsprint factory, designed to supply the total internal demand

It will use a soft wood tree known as "broadleaf", also called "jetpropelled" (*Boswellia serrata*) which grows in 5,000 square miles of forest in the Central Provinces The pulp from several different species will be blended to give the desired quality of paper

The finished product will be of a very fine grade and superior in strength and quality to what is being made in the factories of the West, according to a report made after ten months' experiments by Dr Campbell, Canadian newsprint technologist

The Indian method was developed by P N Nair, a Government employee Before Nair, the Tatas had attempted to manufacture newsprint in India by the same method as the Western As the spruce and fir were found only on Himalayan heights and it was uneconomic to procure timber from there, the attempt failed Later, the Indian Forest Research Institute at Dehra Dun tried with deciduous trees, but found them unsatisfactory A sort of paper could be made from some of them, but it was too weak to run a fast-moving rotary machine

Nair resigned his job in October, 1946, to work whole time on his experiments, and by January, 1947, was able to give convincing proof that newsprint could be manufactured from the "broadleaf" tree By using it as raw material, the cost of manufacture is expected to be 40 per cent lower than that in other countries

Robert A Rankin, consulting industrial engineer of Montreal, and A M Koroleff, director of Woodlands Research, Pulp and Paper Research Institute, Montreal, whose services have been lent by the Canadian Government, are helping to set up the factory

The factory will be located three and one-half miles from Chandni (Khandwa Dist), a small railway station on the Bombay Delhi line At present the area is thick forest The nearest village is two miles distant, with a population of 55 Here the first 500 acres of land, now being cleared, will hold a township of 30,000 people

The factory's authorized capital is Rs 55,000,000 of which only Rs 15,500,000 will be issued The Government of the Central Provinces has agreed to take ten per cent of the share capital, and to give the Nepa Mills (National Newsprint and Paper Mills Ltd) which owns it, all the needed facilities

India's supplies at the present rate, without re-afforestation, will be sufficient for 120 years The "broadleaf" grows 60 feet in 15 years The agricultural plantation on the mill site is in charge of a young Indian woman, Rajul Shah, who graduated from the University of Michigan and is a specialist in plant breeding She supervises the planting of young trees on 1,500 acres a year These will eventually be cut with a full yield every three years—a tree replaced for each one felled

Present capacity of the Nepa Mills is 100 tons a day, but it will be increased to 300 tons within five years

Laying the foundation of the factory at Chandni on December 26 last Pandit R S Shukla, Premier of C P and Berar, said this was the first big industrial enterprise that was being launched in the province with the active support of the Government in pursuance of its industrial policy The demand for newsprint in India was large and expanding totalling at the moment to over 90,000 tons He also referred to the concessions announced by the Government of India that dispelled doubts about the safety of capital and made an earnest appeal to investors to shed all fear and contribute to the industrial regeneration of the country

The present potential productive capacity of 15 paper mills in India is estimated to be about 110,000 tons per annum In 1937-38 the total imports of paper and boards from abroad amounted to about 145,000 tons The present per capital consumption of papers and boards in India may be taken to roughly about 1 4 lb as compared to 150 lb in the U K, 175 lb in Canada and over 300 lb in the U S A Cheap and low-grade writing and printing paper will therefore be required in enormous quantities, for the spread of literacy among the masses, for too long has India remained indifferent to the spread of mass education.

The acute famine of newsprint during the second world war has amply demonstrated the necessity of making the country, as soon as possible, independent of foreign imports of newsprint

PATENTS ENQUIRY COMMITTEE

THERE has been a demand both from industrialists and from others for a review of the laws relating to patents in India with a view to ensuring that the patent system is more conducive to national interests than at present After a careful examination of the position, the Government of India have set up a Committee to review the Patent Laws in India

The terms of reference to the Committee are as follows

(1) To survey and report on the working of the Patent System in India, (2) to examine the existing patent legislation in India and to make recommendations for improving it, particularly with reference to the provisions concerned with the prevention of abuse of patent rights, (3) to consider whether any special restrictions should be imposed on patents regarding food and medicine, (4) to suggest steps for ensuring effective publicity to the patent system and to patent literature, particularly as regards patents obtained by Indian inventors, (5) to consider the necessity and feasibility of setting up a National Patents Trust, (6) to consider the desirability or otherwise of regulating the profession of patent agents, (7) to examine the working of the Patent Office and the services rendered by it to the public and make suitable recommendations for improvement, and (8) to report generally on any improvement that the Committee thinks fit to recommend for enabling the Indian Patent System to be more conducive to national interest, by encouraging invention and the commercial development and use of inventions

The Committee consists of Bakshi Sir Tek Chand, Retired High Court Judge and Member, Constituent Assembly of India (*Chairman*), Sir Gurunath Bewoor, Tata Industries Ltd, New Delhi, Major-General S S Sokhey, Director, Haffkine Institute, Bombay, Mr S M Basu, Solicitor, Calcutta, Mr N Barwell, Barrister, Calcutta, Mr S P Sen, Bengal Chemical and Pharmaceutical Works, Ltd, Calcutta (*Members*), and Dewan Bahadur K Rama Pai (*Member-Secretary*)

Persons who desire to be called as witnesses are requested to apply in writing to the Secretary of the Committee, of Ministry of Industry and Supply, Government of India, New Delhi, giving their full names and addresses, together with a brief memorandum of points in regard to which they desire to give evidence

"Has the Patent System, as it obtains in India, encouraged the development of new inventions for industrial purposes?", is one of the questions asked in a comprehensive Questionnaire prepared by the Patents Enquiry Committee The Questionnaire covers all important aspects of the Patent System, and contains more than 1000 questions grouped under convenient headings, such as, "Patents and Research", "Abuse of Patent Rights", "Patents for Food and Medicine", "Patent Agents", "National Patents Trust", etc

DR B N UPPAL

DR B N UPPAL has been appointed Director of Agriculture, Bombay Province, Poona Dr Uppal graduated from the Punjab University in 1919 and studied Plant Pathology at the Iowa State College of Agriculture He obtained his doctorate there in 1925 While at Iowa he worked as a lecturer for one term and also was a fellow of the experiment station He joined the agricultural department of Bombay province in 1926 as assistant professor of Mycology and acted as Plant Pathologist at the same time He was appointed as Plant Pathologist from 1931 onwards During 1933 he was deputed to England for study in virus diseases of plants by the Imperial Council of Agricultural Research During the war he was entrusted with the storage and supply of potatoes and was made M B E by the then Government for his excellent work In 1945 he succeeded Dr G S Cheema, as Principal and was appointed Director of Agriculture (Research and Education) in May 1947 He has successfully conducted a large number of plant pathological research schemes dealing with virus, wilt, cereal rust, koleroga and bacterial and other diseases He is a member of the American Phyto-Pathological Society and American Botanical Society and a Fellow of the National Institute of Sciences of India He has been associated with the University of Bombay for a number of years and has taken keen interest in the University affairs and development of technical sciences

INDIAN SCIENTIFIC LIAISON OFFICE IN LONDON

DR S BHAGAVANTAM whose appointment as Chief Scientific Liaison Officer in London was announced earlier (see SCIENCE AND CULTURE, September, 1948, p 113) has his office with the Scientific Liaison Office of the other dominions at Africa House, Kingsway, London, W.C. 2.

The functions of the office *inter alia* are as follows

(1) to facilitate the movement of Scientists within the Commonwealth, to provide adequate facilities for them and their work and to arrange contacts for them,

(2) to keep abreast of the latest improvements in techniques and Scientific and technical developments and make this information available to the country,

(3) to facilitate exchange of Scientific information and experimental material such as plants, animal, micro-organisms, etc,

(4) to help, wherever required, in the planning of research or training

The names of scientific visitors from India to the United Kingdom may be intimated to Department of Scientific Research, Government of India, New Delhi, with probable dates of arrival in London, for communication to the I S L O in London as and when such visits take place A short note regarding the purpose of such visits to the U K may also kindly be furnished if possible

ANNOUNCEMENTS

PROF R E MORTIMER WHEELER, Professor of Archaeology in the University of London, formerly Director-General of Archaeology in India, will serve as Adviser to the Government of Pakistan in setting up a department for the exploration and preservation of ancient sites and in forming a Museum at Karachi

THE Executive Committee of the Indian Science Congress Association for the year 1949 50 will be constituted as follows —*President*—Sir K S Krishnan (Delhi), *President-elect*—Prof P C Mahalanobis (Calcutta), *Treasurer*—Rai Bahadur Dr K N Bagchi (Calcutta), *General Secretaries*—Dr B Mukerji (Calcutta) and Dr B Sanjiva Rao (Bangalore), *Members* (elected by ballot)—Dr D S Kothari (New Delhi), Dr B C Guha (Calcutta), Dr U P Basu (Calcutta), Dr Baini Prashad (Delhi), Dr A K Dey (Calcutta), Prof P Rây (Calcutta), Dr A C Ukil (Calcutta), Dr B C Kundu (Chinsurah), Dr B Narayana (Patna) and Mr B K Sarkar (Calcutta)

PROF P C MAHALANOBIS, F R S, has been elected General President of the Indian Science Congress to be held at Poona from January 2 to 7, 1950

The following were elected Sectional Presidents and Sectional Recorders of the 13 sections of the Science Congress *Mathematics*—Prof N M Basu (Aligarh) and Dr B R Seth (New Delhi), *Statistics* Dr P V Sukhatme (New Delhi) and Dr K C Basak (Calcutta); *Physics*—Dr R N Ghosh (Allahabad) and Dr Vikram Sarabhai (Ahmedabad), *Chemistry*—Dr J K Chowdhury (Calcutta) and Dr R D Desai (Bombay), *Geology and Geography*—Mr J Coates (New Delhi) and Prof N L Sharma (Dhanbad), *Botany*—Prof P Maheswari (Eastern Pakistan) and Prof J F R De Almeida (Bombay), *Zoology and Entomology*—Dr B C Basu (Izatnagar) and Dr B S Chauhan (Benares), *Anthropology and Archaeology*—Dr Christoph von Haimendorf (Hyderabad) and Mr Gautam Shankar Roy (Calcutta), *Medical and Veterinary Sciences*—Dr M V Radhakrishna Rao (Bombay) and Dr C R Das Gupta (Calcutta), *Agriculture*—Rai Bahadur R Seth (New Delhi) and Mr L C Sikka (Calcutta), *Physiology*—Dr Kalidas Mitra (New Delhi) and Dr N N Das (Calcutta), *Psychology and Education Science*—Prof Kali Prasad (Lucknow) and Mr L J Bhatt (Baroda), *Engineering and Metallurgy*—Dr D R Malhotra (Ajmer) and Mr J Datt (Patna)

THE Trustees of the Lady Tata Memorial Trust are offering six scholarships of Rs 250/- each per month for the year 1949-50 commencing from 1st July 1949 Applicants must be of Indian nationality and graduates in Medicine or Science of a recognised University The scholarships are tenable in India only and the holders must undertake to work whole-time under the direction of the head of a recognised research Institute or Laboratory on a subject of scientific investigation that must have a bearing either directly or indirectly on the alleviation of human suffering from disease Candidates can obtain these instructions and other information they desire from the Secretary of the above Trust, Bombay House, Bruce Street, Fort, Bombay 1

THE Elliott Prize for 1949 for Scientific Research in chemistry will be awarded to the author of the best paper giving the results of original research carried out by the candidate in Chemistry and published during the years 1945 48 inclusive Preference will be given to researches leading to discoveries likely to develop the industrial resources of Bengal, Bihar or Orissa

The prizes for the next four years will be offered as follows —

(i) 1950—Physics—papers to be submitted by the end of June, 1950

(ii) 1951—Geology and Biology (including Pathology and Physiology)—by the end of June, 1951

(iii) 1952—Mathematics—by the end of June, 1952

(iv) 1953—Chemistry—by the end of June, 1953

AT the second Annual General Meeting of the Phyto-Pathological Society held on January 2, 1949

at Allahabad, the following office-bearers of the Society were elected

President Dr S R Bose, *Vice-President* Dr R S Vasudeva, *Councillors* (Northern Zone)-- Dr R Prasada, (Mid-Eastern Zone)—Dr K C Mehta, (Eastern Zone)—Mr S Y Padmanabhan, (Central Zone, general)—Dr M J Thirumalachar, (Western Zone)—Dr M K Patel, (Southern Zone)—Mr K M Thomas, *Secretary-Treasurer* Dr B B Mundkur

Dr S L Hora, Director, Zoological Survey of India and formerly Director of Fisheries, Bengal, has been invited to prepare a paper on *Pond Culture of Warm Water Fishes* for presentation to the United Nations' Scientific Conference on the Conservation and Utilization of Resources to be held in the United States of America in May or June, 1949 It is a well deserved recognition of the stimulus given by Dr Hora to the culture of fishes in ponds throughout India and we congratulate him on this distinction

Prof K P Chattopadhyay, Head of the Department of Anthropology, Calcutta University has been elected Vice-President, Commission Internationale Des Arts et Traditions Populaires Institut International De Recherches Ethnographiques et Folkloriques, Paris, and also Corresponding Member of the L'Ecole Francaise d'Extreme Orient, Hanoi, Indo-China

Dr B S Guha, Director, Department of Anthropology, Government of India, and Sree S P Sen, of the College of Engineering and Technology, Jadavpur have also been appointed a Corresponding Member of the L'Ecole Francaise d'Extreme Orient

ACKNOWLEDGMENT

We are thankful to Sree D K Mukherjee for contributing the news item entitled "Eighth International Congress of Genetics" (see SCIENCE AND CULTURE, January, 1949, p 281) Sree Mukherjee represented India along with others at this Congress session and was a student at the School of Agriculture, Cambridge, from where he has obtained the Diploma in Agriculture and also worked with Prof F G Gregory at the Imperial College of Science and Technology, London on "Vernalization of Excised Embryo"

BOOK REVIEWS

Modern Workshop Technology Part I—Materials and Processes—Edited by Professor H Wright Baker, D Sc Demy 8vo, pp vii+445, with 215 illustrations, 1948 Cleaver-Hume Press Ltd 28 *sh* (net)

The subject of workshop technology has been dealt with by many authors in the past The present work differs from these in two broad respects Firstly, within some 450 pages is amassed information on practically all the engineering materials capable of being fabricated in a workshop as well as their methods of produtcion and modes of application Secondly, the individual chapters, each comprising of some definite phase of material or process are written by authors who apart from being well versed in their own craftsmanship, are technologists of standing Each chapter, thus forms by itself a complete and self-contained text, including references of books and periodicals at the end

The first eight chapters cover the topic on iron and steel, nine and ten deal with the various methods of welding and their applications in engineering, while the other six chapters from eleven to sixteen cover respectively the subjects of aluminium and magnesium, nickel and high-nickel alloys, copper and copper alloys, diecasting, powder metallurgy, and engineering plastics The last chapter, is a survey of the methods of mechanical testing and inspection of engineering materials The main emphasis, in the whole text, is laid on the technology of metallic materials, plastics being the only non-metallic variety included in the discussion The reviewer believes that the inclusion of a chapter on timber and carpentry and the composite metal plywood structures, a descrption of the modern "shot-peening" methods of increasing the strain endurance of metallic components, and a more detailed enumeration of the principles underlying the non-destructive testing technique, like radiological and stress-coat analysis, would have further enhanced the value of the book In spite of these ommisions, this present volume stands out as one of the very few publications on workshop technology which harmoniously balance, the theoretical aspect of engineering with the practical background of industry The

credit for this is due to the close co-operation of the authors of the various chapters with their able general editor, Professor Baker, who occupies the chair of mechanical engineering at the University of Manchester The book is written with great clarity and lucidity and the large number of illustrations render it a useful work of reference for all interested in workshop technology

S K G

Soil Erosion—Its Prevention and Control—Government of Madras, 1948 Price Rs 6/-

Soil erosion as a problem of national importance has only recently been recognised in India The extensive nature of the damage caused by soil erosion requires a coordinated attack by agronomists, irrigation engineers and forest officers The volume under review is in this respect an authoritative treatise since it is the outcome of a concerted effort by experts A soil scientist of to-day will, however, fail to find much of the relevant topics so far as the soil aspect of erosion is concerned Illustrative chapters dealing with the control of erosion are expected to be very helpful to field workers Another important feature of the volume is that the suggested methods are either tested with Indian soils and under Indian conditions or are especially meant to be applicable to them, although in many cases only local problems have been cited The almost faultless printing and get-up including sketches and photographs go to the great credit of the publishers

S K M

A Psychology of Growth—By Bert I Beverly, M D (McGraw Hill Book Co Inc , N Y and London, 1947) Price $3 00

The book contains many useful information regarding the mental development of the child beginning from its birth up to the adolescent stages Psychology has been able to teach us this much at least that in the course of this development a child has regularly to pass through critical situations which, unless he is helped to meet adequately, may be responsible for the creation of permanent injuries to his mental constitution Such children will not be able to adjust themselves to society and their mal adjustment may be expressed in various ways in later life, *e g*, in delinquent and other problem behaviours, in mental diseases, etc

The value of the book under review lies particularly in illustrative cases that the author has cited and the practical suggestions that he has given Parents with whom the primary responsibility for the healthy mental development of their children lies, will be greatly benefitted by these suggestions The book will also help them to get an insight into the motives of their children's behaviours and to show them how much they themselves are involved in these motives

The style is simple and lucid enough for everybody to understand Though technical terms have been avoided the scientific outlook has not been impaired The book can be recommended to all who are entrusted with the task of looking after developing children

S C M

Modern Colloids - Robert B Dean Published by D Van Nostrand Company, Inc , New York, 1948 Price $3 75 or 21 *sh* net

The book under review deals in an elementary manner with the modern trends in the science of colloids The once neglected "turbid science" has already become one of the exact sciences and its horizon is fast expanding Its importance is now being gradually felt in such diverse sciences as biology and medicine, in the study of proteins, agriculture, chemistry of high polymers, and also in a large number of industrial processes Perhaps no other science has drawn so liberally on the tools and concepts of pure sciences as that of colloids for its development The book in its small compass has focussed attention to these various aspects

The book, according to the author, is designed to serve as an introduction to the behaviour of colloidal materials , it can as well be taken as a good argument for teaching the science of colloids to undergraduate students The implications of the more difficult topics, *e g*, high polymers, recent theories of adsorption, and colloidal electrolytes will, however, be less convincing to them, in the way they have been treated in the book

The diagrams in the text and the questions and problems given at the end of the book are very instructive References at the end of each chapter are also fortunately up to-date, and will be enormously helpful to advance students

The twelve chapters into which the book is divided have not been arranged perhaps in a logical manner For instance, the fundamentals of electrokinetic phenomena discussed in Chapter 9 ought to have been put just after Chapter 5 Chapter 2 which gives brief descriptions of important pieces of apparatus used in colloid chemical studies lacks the necessary practical hints for the students , moreover, it could be supplemented with another chapter dealing with the preparation of colloids and the general techniques used in their investigations

The book is meant to serve many purposes. This has necessitated the inclusion of a large number of topics in a small compass. All of them have not therefore been treated with proportionate justice, but the author must be thanked for covering a wide range of subjects and incorporating a lot of information on most of the current thoughts and uses of colloid chemistry.

Oversimplification, here and there, like those made at the beginning of page 92 regarding the definition of ions could have better been avoided. It is inaccurate to suggest that the reactions shown by the equations on page 102 represent anion exchange processes.

S K M

Ancient Indian Life—By Sri Jogesh Chandra Ray. Pp i-viii, and 1-212. Published by P R Sen, 1, Dover Lane, Calcutta 29, 1948. Price Rs 8/-.

The book aims at presenting a picture of ancient Indian life in its various aspects, and consists of seven chapters which were published before in various journals. By reason of his long experience of life, his scientific habit of looking at things and his love and knowledge of India's past, his equipment for undertaking such a work is unquestionable. Professor Ray has been long working in this field and the papers collected in this volume required a re-publication in the form of a book so that at the present juncture of India's culture, just free from foreign domination, she might look back to her past to gather strength and direction for building up her future.

Prof Ray feels that 'foreign culture imbibed from boyhood tends to engender (in us) a bias of education which belittles what is indigenous because it is unknown and unlearnt. Theological and philosophical doctrines of Hindus are at the same time so often dinned into our ears that we have almost begun to think that people in ancient days lived a life of austere asceticism, seeking temples and groves to worship their deities and to meditate on the Great One. That they had other spheres of activity, that they developed a state of society in which were represented various departments of temporal knowledge, though repeatedly shown in history, are often lost sight of. Such a one-sided view of Hindu civilization tends to distort the true perspective and to create a morbid sentimentality which the rough contact with the West does not always succeed in curing.' We greatly endorse his sentiments expressed in these lines.

The first chapter, Life in Ancient India, supplied basis and introduction for the next three chapters, namely, Food and Drink in Ancient India, Sugar Industry in Ancient India and Textile Industry in Ancient India. The last three chapters which cover comparatively new grounds describe Fire-Arms in Ancient India, The Days of Hindu Calendar and the Eugenics of Hindu Marriage.

Professor Ray's patriotic leanings are evident in the chapters as we go through them, and we may not accept all his interpretations, but that is a question of mere detail. One cannot fail to be struck by the truth of the majority of his statement of facts.

His interpretation for instance, of the origin of caste system in India on the basis of the colours (*varna*) of the skin is no longer seriously taken into consideration. A similar theory in solution of this problem was advanced by Risley in 1908 and many others followed, but none of them are taken as final. A review of all the theories so far advanced on this subject, was made in a paper contributed by Professor Chattopadhyaya to the *J A S B* in 1935. Could one seriously take into consideration the statement that 'It is likely the occupations favoured the development of shades of red and yellow in the skins of Kshatriyas and Vaisyas respectively'? Modern Science does not support this view. Prof Ray in the pages of his book has admirably drawn a glorious portrait of life in Ancient India, but like him we would also ask, 'How is it that the Brahmans, who had thought out an admirable scheme of life and put it into practice, degenerated and brought upon themselves the miseries of the *Kali* era, the Iron Age, which they themselves portrayed in sombre colours'? (p 209). We would expect an answer from him.

When one goes through the pages of the book one notes with regret the omission of references to works of such pioneer Indian authors as Dr Rajendralal Mitra, Sir P C Ray and others. The author of the Met Med of Hindus has been given erroneously as Dr R C Dutt (p 101 fn), it should be Dr U C Dutt. Some typographical mistakes are also there, such as, *chenna* (p 11), tract perhaps for treatise, at p 30, *grața*, p 36, *extent*, p 66, *Vâjñavalkya*, p 74, Sankrit, p 90, *rat*, p 142, etc, but they are of minor importance.

In conclusion this may be said that everybody who is interested in knowing the question of India's past, and who so often takes pride in India's past achievements will be well advised to go through the pages of this well documented book and be furnished with a knowledge of the basis of their belief.

G P M.

LETTERS TO THE EDITOR

[The Editors are not responsible for the views expressed in the letters]

ELECTROSMOSIS IN SOIL MECHANICS

THE origin of soil mechanics is obscured and lies buried in the oblivion Perhaps it was Coulomb[1] who first published in 1773 his classical theory on soil mechanics most of which is now refuted This was followed later by Poncelet and Rankine[2] who are now looked upon as pioneers in this field Since 1936 when the First International Congress on Soil Mechanics and Foundation Engineering was inaugurated at Harvard University, Camb, Mass, U S A, great advances have been made in this branch of applied mechanics both from the theoretical and practical points of view, which have ultimately been of tremendous use in the construction and design of dams, highways, bridges, foundations and tunnels The role of electrokinetics in soil mechanics which appears to have been studied very recently only in a few of the European countries like Germany, Norway and Switzerland forms the most novel and modern development of this young science

The method of draining fine grained soils by electrokinetics first described by Casagrande in 1941 has been tried out in Germany The Swiss Federal Technical College, Zurich, has also undertaken a close investigation of this subject[3] To overcome the difficulty encountered in excavating fine grained soils, such as clay, loess or silt, whose high capillarity may render the usual methods of drainage ineffective, large scale experiments with an electro-osmotic process were carried out by the German State Railway Directorate (Reichsbahndirektion) at Hanover[4] During the war the Germans made three main applications of the process, *viz*, (*i*) on a cutting one mile long near Salzgitter, (*ii*) on the U boat pens, at Trondjhem and (*iii*) on a cutting and tunnel at Trondjhem[5]

The general principle of activating the ground water by means of a direct electric current is shown in fig 1 By inserting one electrode in a well tube having a filter point, sinking a second electrode at another point and connecting them with a d c source, an electric field is produced in the soil Simultaneously a portion of the electric current flowing from the positive to the negative electrode passes through the ground water as well as the soil submerged in it This current produces electrosmosis in the capillaries of the fine-grained soil, thereby causing the water particles to be transported through the interstices and in the direction of the charged field By connecting the electrode in the well tube with the positive polarity an amount of water

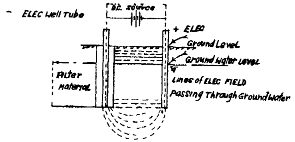

FIG 1

greatly in excess of that flowing under the influence of the existing hydraulic head is transported to the well

The electrokinetic phenomena is due to the existence of an electric potential difference between the interface of two contacting media, (metallic as well as non-metallic) Thus at the interface of soil and water a potential difference is produced in the boundary layer which is known as electrokinetic or "ζ" potential

A typical hydraulic-electrosmotic flow through capillary is shown in Fig 2 According to Schaad

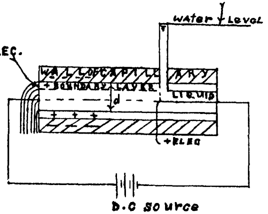

FIG 2

and Haefeli[3] the velocity of fluid flow through the capillary is given by the Helmholtz-Perrin-Smoluchowski equation in the form $u = u_0 + u_1$ where u_0 is an expression for laminar flow as established by

Poiseuille and u_1 is the velocity of flow due to the action of the current of electricity If 'd' is the capillary diam , and 'l' its length, η the viscosity of the fluid, 'p' is the pressure difference due to static load Iw, specific resistance and D' the dielectric constant of the fluid, and 'J' is the current density in the capillary, then

$$u_0 = \frac{d^2 p}{32 \eta l}$$

and

$$u_1 = \zeta \ PwDj/4 \pi \eta$$

Therefore combining and simplifying,

$$u = \frac{1}{32 \, l\eta} \ (pd^2 + 2\,6\,\zeta PwDj)$$

A similar equation can also be derived for laminar filter flow, V_f in the form, $V_f = kI + k_e E$ where k is the permeability constant, I is the hydraulic pressure gradient, E is the strength of electric field, and k_e is the electrosmotic constant defined as the velocity of filter flow prevailing with an electric field strength of $E = 1$ volt per cm

The principles briefly explained above though simple in appearance involve mathematical and physical conceptions for the full development of an exact theory, which is now being seriously taken up for study in the Swiss Federal Technical College, Zurich The findings of that school of research investigators will be eagerly awaited by all interested in soil mechanics and none the less by engineers of this country where this branch of soil science is slowly being introduced and applied in the various engineering development and planning schemes

Bombay,
16-3-1948

S K GHASWALA

[1] K Terzaghi, *Jnl I C E* 12 106 1939 (45th James Forrest Lecture)
[2] ——— - ——— Theoretical Soil Mechanics John Wiley & Sons 1943
[3] Schw Bauzeitung 65 Nos 16 18, pp 216, 223, 235 (Extensive bibliography is given)
[4] L Casagrande Strasse 8 No 19/20 324, 1941
[5] B I O S Final Rept Item No 33 Lond , H M Stationery Office

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FURTHER NON RAMANUJAN CONGRUENCE PROPERTIES OF THE PARTITION FUNCTION

PREVIOUSLY the author[3] has demonstrated the existence of congruence properties of the partition function which are not covered by Ramanujan's conjecture, *viz* , if $\delta = 5^a 7^b 11^c$ and $24\lambda \equiv 1 \pmod{\delta}$, then $p(m\delta + \lambda) \equiv 0 \pmod{\delta}$ for every m

In fact it was shown that

$$p(49m + i) \equiv 0 \pmod{49},$$

where $i = 19, 33, 40$ and 47

The only case embraced by Ramanujan's conjecture is that corresponding to $i = 47$ This however has long ceased to be a conjecture and Ramanujan himself was responsible for it

It was also observed that similar non-Ramanujan congruence properties do not exist in respect of the moduli 25 and 121 It is pertinent to enquire whether non-Ramanujan congruences in respect of higher powers of 5, 7, and 11 exist or not Such an enquiry has led the writer to the rather striking fact that such properties do exist at least in relation to the modulus 125 He has satisfied himself that

$$p(125m + i) \equiv 0 \pmod{125},$$

where $i = 74$, 99 and 124

The case $i = 99$ only was put forward by Ramanujan as a conjecture Subsequently this was established by Krecmar[1] and the more general Ramanujan congruence in respect of any modulus 5^a was finally proved by Watson[4]

The method employed by the present writer in arriving at these new results is essentially the same as that used in his previous note But he is now not in the happy position of making a start with an already established identity Thus in respect of the modulus 49 the starting point was Ramanujan's remarkable identity

$$p(5) + p(12)x + p(19)x^2 + \dots = 7f^3(x^7)/f^4(x) + 49xf^7(x^7)/f^8(x),$$

where $f(x) = (1-x)(1-x^2)(1-x^3) \dots$

This throws into bold relief the relation

$$p(7m + 5) \equiv 0 \pmod{7}$$

In a similar study in respect of the modulus 125 it is only natural to look for an analogous identity for

$$p(24) + p(49)x + p(74)x^2 + \dots$$

which brings out the known relation

$$p(25m + 24) \equiv 0 \pmod{25}$$

with equal prominence But such an identity was not in hand and the writer has had to develop his own scheme of tackling such problems The development is highly encouraging and a very brief indication has already been given by the author[5] Incidentally it may be added that this scheme is equally well adapted to other arithmetical functions, for example, there is the similarly derived identity, *viz* ,

$$\sigma(7) + \sigma(15)x + \sigma(23)x^2 + \dots = 8f^6(x^2)f^2(x^8)/f^3(x)f(x^4),$$

where $\sigma(x)$ is the sum of the divisors of x This also brings out explicitly the relation,

$$\sigma(8m + 7) \equiv 0 \pmod{8}$$

All these and other allied results together with their proofs will be published elsewhere

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[1] Krecmar, W, *Bull Acad Sci URSS*, *7*, 763-800, 1933
[2] Lahiri, D B, Paper presented to the 15th biennial conference of the Indian Mathematical Society, Waltair, 1947
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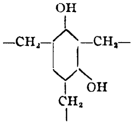
[4] Watson, G N, *Journal für Math*, *179*, 97 128, 1938

THE MAXIMUM EXCHANGE CAPACITIES OF ION EXCHANGE RESINS FROM THEIR TITRATION CURVES

THE maximum exchange capacity that can be obtained by chemical treatments of synthetic resins, both cation and anion exchangers, has been a subject of some controversy In the case of a cation exchanger, *e g*, a resorcinol-formaldehyde resin, a value as high as 1400 m e per 100 g has been reported [1] The theoretical value of such a resin calculated from the formula,



containing two exchange spots corresponding to the two OH groups, is 1560 m e per 100 g In a previous note[2] it was reported that a fine suspension of a resorcinol-formaldehyde resin, obtained by collecting the suspended particles after 8 hour's sedimentation, gave with caustic soda a mean exchange value of 1240 m e (calculated on oven dry basis), which agreed closely with the theoretical value, 1220 m e assuming that the exchangeable H^+ ions are hydrated as H_3O^+ A suspension of still finer particles of this resin was sampled from a depth of 10 cm after 20 hour's settling, and was subjected to potentiometric titration with caustic soda using the hydrogen electrode The equilibrium was attained very quickly The titration curve shows a weak dibasic acid character and two inflexion points, evidently corresponding to the two OH groups of the resorcinol units The total exchange capacity calculated from the second inflexion point of the curve is 1261 m e per 100 g of the oven-dry material, which agrees with the previously observed value

An anion exchange resin prepared by the condensation of m-phenylene-diamine with formaldehyde contains two NH_2 groups exactly in the same positions as the OH groups of the resorcinol-formaldehyde resin The highest value reported in the case of such a resin falls far short of the theoretical value, which, calculated on the same basis as the acid resins, comes to be 1234 m e with the hydrated exchange spots *i e*, as NH_3OH^-, and 1587 for the nonhydrated ones The basic resin mass prepared as above was ground and a suspension of particles not settling below 10 cm depth after 8 hours was collected and purified by dialysis after treatment with caustic soda The fine suspension was then electrometrically titrated with standard hydrochloric acid solution using the quinhydrone electrode (and not the hydrogen electrode since the resin had a strong tendency to get deposited on the platinised electrode) The titration curve shows in this case also two inflexion points, and the resin reacted like a diacidic base The exchange capacity calculated from the curve was 1270 m e per 100 g of oven-dry material In both the titration curves the exchange capacities calculated from the first inflexion points are exactly half of those calculated from the second inflexion points The pure resorcinol and the metaphenylenediamine were titrated in a similar manner with caustic soda and hydrochloric acid solutions respectively The *pK* values of the acid and basic resins calculated from the titration curves are found to be slightly greater than those of the pure resorcinol and metaphenylenediamine The details will shortly be published elsewhere

My thanks are due to Dr S K Mukherjee of the Department of Applied Chemistry for suggestion, guidance and full laboratory facilities

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Calcutta, 18-10-1948

[1] Akeroyd & Broughton, *J Phys Chem* *42*, 343, 1938
[2] Ganguli, A K & Gupta, S L, SCIENCE AND CULTURE, *14*, 81, 1948

BASE EXCHANGE PROPERTIES OF QUARTZ AND SILICA GEL

VAN DER MAULEN[1] stated that quartz, wollastonite, tremolite and similar minerals have no cation exchange properties because they do not contain aluminium in the lattice Kelley and Jenny[2] found very little NH_4-adsorption from NH_4AC solution by quartz which has been ground for a long time Mitra,[3] also Mitra and Rajagopalan[4] have attempted to develop a theory of base exchange properties of layer-lattice silicates according to which SiO_4-should

possess no exchange capacity Mitra[3] cites Kelley and Jenny's[2] experiment where they failed to detect any appreciable cation binding power of the "ground" quartz Jackson and Truog,[5] however, found a cation binding capacity of quartz to the extent of 60 me per 100 grms of the material Van der Maulen[1] leached finely powdered quartz and also silica jelly with 0 5N calcium acetate solution of $pH=8$ presumably to exchange H^+-ions and found that "lime" adsorbed by the particles was subsequently replaceable by 0 5N NH_4NO_3 The NH_4NO_3 leached material which was washed with 70 per cent alcohol to remove any adhering nitrate was found not to contain any NH_4^+ Kelley and Jenny[2] in their experiments with finely ground talc found that much more of Mg^{++} comes out on treatment with neutral NH_4OC but only a trace of NH_4^+ is adsorbed They suggested that the NH_4-ions of the NH_4AC solution replace the Mg^{++}-ions which are present on the surface of the broken octahedra resulting in the formation of NH_4-Silicate at the site of exchange The latter is an unstable compound and breaks up into H-Silicate and NH_3 or the H^+-ions of the solution replace the NH_4^+-ions of the Silicate, so that finally no adsorption of NH_4^+ is observed

From these experiments it appears clear that the method of NH_4 adsorption is unsuitable for the determination of the exchange capacity of systems like Silica

The following experiments were therefore performed with samples of quartz and silicagel to determine their exchange capacities, if any

Silicagel prepared from sodium silicate and hydrochloric acid was completely freed from adsorbed HCl by continuous washing with conductivity water for several months The gel was then dried for 24 hours in an electric oven at a temperature of 110°C A portion of this was ground in an agate mortar for 24 hours Another portion of the gel was ignited in a muffle furnace for 3 hours (temp above 900°C), cooled and ground for 14 hours The gel gave no tests for Cl, Fe or Al

The sample of pure quartz (SiO_2) was ground in an agate mortar and particles $<$ 0 002 mm corresponding to the clay fraction and 0 02 to 0 002 mm diameter corresponding to silt fraction were separated by sedimentation Each of the fractions were leached with $\frac{N}{10}$ HCl and washed with conductivity water till free from Cl^1 ion The clay fraction was then electrodialised and the sol stored in jena bottle (colloid content 7 68 grams/litre) The silt fraction was dried in an electric oven at 110°C for 8 hours and then cooled in a desiccator

Base exchange capacities (b e c) were determined by the $BaAC_2$ method of Parker[6] The b e c was also determined in the following way A definite amount of the sample kept in suspension with conductivity water was titrated with $\frac{N}{20}$ KOH Soln using phenolpthalien as indicator till the pink colour persisted for 3 minutes Then a volume of a Saturated Neutral Solution of KCl equal to that of the suspension was added to it and titration continued as before The sum of these two titres gives the total b e c of the samples Similar titrations were made with $\frac{N}{20}$ NH_4OH in the absence and the presence of Saturated NH_4Cl solution using Wesselow's mixed indicator Results are given below

Samples	Parker	KOH $\frac{N}{20}$	KOH $\frac{N}{20}$ KCl	NH_4OH $\frac{N}{20}$	NH_4OH $\frac{N}{20}$ NH_4Cl
Ovendry 24 hours ground Silicagel		8 2	80 8	Trace	16
Ignited, 14 hours ground Silicagel	22 3	6 02	45 74	0 0	
Clay fraction of quartz	5 2	0 5	5 3	0 0	
Silt fraction of quartz	0 62	0 0	0 60	0 0	0 26

Both the quartz and the silicagel are found to possess base exchange capacities But the b e c of the former is much lower than that of the latter The silicagel has an open structure and therefore offers a larger number of exchange spots The quartz on the other hand, is compact in structure and therefore exchange reaction is confined to the surface Little or no exchange capacity is obtained by titration with NH_4OH alone In the presence of NH_4Cl solution an appreciable exchange capacity is no doubt observed but the values are much less than those obtained by the other two methods Neither the silicagel, nor the quartz in any form shows phosphate adsorption from phosphoric acid solution

My grateful thanks are due to Dr S K Mukherjee, Department of Applied Chemistry, Calcutta University, for his continued interest in the work and for giving full laboratory facilities

ANIL KUMAR GANGULY

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Calcutta, 10-11-1948

[1] Van der Maulen, *Rec Trans Chem*, **54**, 107-110, 1935
[2] Kelley and Jenny, *Soil Sci*, **41**, 367, 1936
[3] Mitra, *J Ind Chem Soc*, **23**, 386, 1946
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RISE OF WATER IN SOILS

THERE seems to be a general agreement that the rate of rise of pure water in soils kept vertically in tubes follows a law[1] of the nature $\frac{h^n}{t} = m$ where h = height through which water rises, t = time, m = a constant depending on the nature of the soil, and n = another constant whose value varies between 2 1 and 2 2 When the tube is kept horizontally, $n = 2$ and the relation $\frac{h^2}{t} = m$ holds good, so that the curve between h and t follows exactly the parabolic law

Some observations of this type have been taken for the Indian soils by Ram Das and Mallik[2] Calculations show that even in some of the vertical cases of the rise of water, the parabolic law is followed, i e, the relation $\frac{h^2}{t} = m$ holds good In some cases n lies between 3 and 4, and in some cases the relation $\frac{h^n}{t} = m$ does not hold good at all Some of the cases follow the exponential law Thus it is found that the law $\frac{h^n}{t} = m$ is not universal In those cases where it holds good n lies between 2 and 4 In those cases where it does not hold good, an exponential law is followed This seems to depend upon the pore space, the permeability and the nature of the soil in the tube

Thanks are due to Dr R K Asundi for the interest in the work

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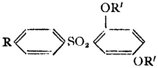
[1] Krynine, D P, *Soil Mechanics* p 35, 1941
[2] Ram Das, L A and Mallik, A K, *Proc Ind Acad Sci* A, *16*, 1, 1943

ON THE ACTIVITY OF CERTAIN HYDROXY SULPHONES AGAINST *E TYPHOSA*

WHILE *p*-aminobenzoic acid annuls the growth inhibiting action of the majority of sulfa drugs against most bacteria, this should be regarded as only one phase of the possible actions of these drugs against micro-organisms as otherwise it would be difficult to account for the activity of the compounds that are not antagonized by *p*-aminobenzoic acid This suggests that most probably more than one mechanisms are involved, only one of which has the sulfanilamide-*p*-aminobenzoic acid relationship Complete elucidation of the metabolic functions of the micro-organism may lead to the synthesis of drugs effective against those organisms insensitive to sulfa drug With this end in view a work has been undertaken for the evolution of a newer type of chemotherapeutic agent

During our investigations[1, 2] with sulphones it came to our notice that some of them are not antagonized by *p*-aminobenzoic acid[3, 4, 5] This characteristic as well as their widened activity led us to the synthesis of some sulphones of the type (I) (*cf*, Buttle *et al*[6]) whose chemical properties would be described elsewhere, in this note their *in vitro* activity against certain gram-negative organisms is being recorded to show that they are not exhibiting sulfanilamide-like type of activity



(I)

Where R = NH_2, NH_2CH_2-, MeCONH–,
Me CO NH CH_2-,

and R′ = H, or, Me

The bacteriostatic activity (Table I) and the inhibitory action (Table II) were ascertained by serial dilution method and streak agar technique respectively

TABLE I

BACTERIOSTATIC ACTIVITY

Inoculum 500 cells from 18 hrs meat infusion agar culture, Temp 37 5°, Medium 1% peptone water, *p*H 7 8—8 0

No	Organism	Concentration of the Drug per c c	
		(I) R = NH_2, R = H (A)	(II) R = CH_2NH_2, HCl, R′ = H – (F)
(*i*)	*E Coli* cs	>0 4 but <1 0	>0 5 but <1 0
(*ii*)	*Sal Schott*	,, 0 4 ,, ,, 1 0	,, 0 5 ,, ,, 1 5
(*iii*)	*E typhosa*	,, 0 04 ,, ,, 0 06	,, 0 04 ,, ,, 0 06
(*iv*)	*Shig dysent* (Shiga)	,, 0 04 ,, ,, 0 06	,, 0 04 ,, ,, 0 06
(*v*)	*Shig p dysent* (Flex)	,, 0 03 ,, ,, 0 4	,, 0 3 ,, ,, 0 4
(*vi*)	*V cholerae* (*Inaba*)	,, 0 08 ,, ,, 1 0	,, 0 1 , ,, 0 14

TABLE II

INHIBITORY ACTION

Growth = +
No growth = −

No	Compound	Organisms					
		E coli	*Sal Sch*	*E typhosa*	*S dysent* (Shig)	*Shig p dysent* (Flex)	*V cholerae* (Inaba)
A	(I), $R-NH_2$, $R'-H$	−	−	−	−	−	−
B	(I), $R=NH\,COCH_3$, $R'=H$	+	+		−	−	−
C	(I), $R-NH_2$ HCl, $R'=H$	−	−	−	−	−	−
D	(I), $R-NH_2$, $R'=Me$	+	+	+	+	+	+
E	(I), $R-CH_2NH_2$ HCl, $R'=H$	−	−	−	−	−	−
F	(I), $R-CH_2NH\,COCH_3$, $R=H$	+	+	−	−	−	−
G	(I), $R-CH_2NH_2$, $R-Me$	+	+	+	+	+	+
H	Me $SO_2\,C_6H_4\,CH_2NH_2$ HCl	−	−	−	−	−	−
I	M2 $SO_2\,C_6H_4\,CH_2$ NH CO Me	+	+	+	+	+	+
J	Sulfathiazole	−	−	−	−	−	−
K	Acetyl sulfathiazole	+	+	+	+	+	+

It may be recorded that the hydroxy sulphone (A) (Table II) is antagonized by *p*-amino benzoic acid in a concentration of 40 μ gm per c c against *E coli* but not against *E typhosa* This latter non-sulfanilamide-like type of activity is also being manifested from growth inhibitory power of its derivative (B) where the free amino group has been protected by acetylation Similar acetylation of a non-hydroxy sulphone (H) or, even the potent sulfathiazole (J) however, completely annuls the growth inhibitory power (*cf*, compounds I and K in Table II) The activity of the hydroxy sulphone (A) is not being noticed in the compound (D) where the hydroxy group has been methylated Is then a prototropic change being again involved in imparting this newer type of bacteriostatic action? All these characteristics are also being found in another hydroxy sulphone derivative (F, Table II) From Table I, it may again be noticed that it is against *E typhosa* as well as *Shig dysent* (Shiga) that these hydroxy sulphones, 2, 5-dihydroxy phenyl 4-amino- (A) and -4-aminomethyl (F) sulphones are exerting their maximum bacteriostatic action Further investigations may show whether in these compounds would be found a valuable remedy against *E typhosa* which is not yet so susceptible to a sulfa therapy

N K S RAO
K R CHANDRAN
U P BASU

Bengal Immunity Research Institute,
Calcutta, 22-11-1948

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ON THE NATURE OF COMPLEX FORMATION BETWEEN CUPRIC ION (CU^{++}) AND PYRO PHOSPHATE RADICAL ($P_2O_7^{-IV}$)

COPPER pyrophosphate dissolves in sodium pyrophosphate solution giving rise to a deep blue-solution Kolthoff[5] has observed that in presence of excess of Na-pyrophosphate Cu^{++} does not liberate iodine from potassium iodide solution This reaction has been utilised by Kapur and Verma[4] in the estimation of iodide in presence of cupric ion Attempts have been made to deposit copper electrolytically from sodium-copper-pyrophosphate solution Although so much use of the reaction between cupric ion and pyrophosphate radical has been made, nothing is known about the exact mechanism of the reaction in solution Fleitmann and Hennberg[3] and Pahl[7] isolated three compounds of the formula $Na_4P_2O_7$ $3Cu_2P_2O_7$ $7H_2O$, $Na_4P_2O_7$ $Cu_2P_2O_7$ $1\frac{1}{2}H_2O$ and $3Na_4P_2O_7$ $Cu_2P_2O_7$ $32H_2O$ or $24H_2O$ Of these compounds, the first two are sparingly soluble whereas the last one is freely soluble in water According to Basett and Bedwell,[1] the compound $3Na_4P_2O_7$ $Cu_2P_2O_7$ $32H_2O$ is a complex salt containing copper in the anion They have not, however, given any positive evidence in its favour Recently Mecutcheson and Raymond[6] have tried to show that in copper ethylene-diamine pyrophosphate solution copper is present in the anion too The arguments presented by them are not very convincing particularly when no transport experiment has been made

The author has studied the reaction between cupric ion (Cu^{+2}) and pyrophosphate radical ($P_2O_7^{-4}$) by different physico-chemical methods such as transport, thermometric, conductometric * and *p*H-measurements

The transport apparatus used, was due to Clement Duval [2] Copper was detected with Rubeanic acid and was found to be present in the anode-limb.

Thus it can be concluded that complex ion, containing copper in the anion is present in a mixture of excess sodium-pyrophosphate and Cu-salt solutions. Thermometric titrations of sodium pyrophosphate with copper salt solutions indicate that two complex ions, of the type $[Cu(P_2O_7)]^{-2}$ and $[Cu(P_2O_7)_2]^{-6}$ exist in the solution. Similar titrations by conductometric method, also support the above results. In conductometric titrations, the break corresponding to normal copper pyrophosphate appears when 1.9 mols of copper salt has been added to 1 mol of sodium pyrophosphate solution. The pH of solutions containing a definite amount of sodium pyrophosphate solution and different quantities of Cu-salt show a sharp change at the point pyro : copper equal to 2 : 1, indicating the existence of the complex ion of the type $[Cu(P_2O_7)_2]^{-6}$. The second sharp fall in pH of the mixture takes place after the point corresponding to the compound $Na_4P_2O_7 \cdot 3Cu_2P_2O_7 \times H_2O$. The pH of the mixture again falls very sharply when the point corrresponding to the normal copper-pyrophosphate is reached. Thus the above methods indicate without any doubt that in a mixture of excess of sodium pyrophosphate and Cu-salt solutions two complex ions of the type $[Cu(P_2O_7)]^{-2}$ and $[Cu(P_2O_7)_2]^{-6}$ exist.

The reaction between cupric ion (Cu^{++}) and pyrophosphate in solution may be represented by either of the following ways:

$$\begin{aligned} &Cu^{+2} + P_2O_7^{-4} \rightleftharpoons [Cu(P_2O_7)]^{-2} \\ &[Cu(P_2O_7)]^{-2} + P_2O_7^{-4} \rightleftharpoons [Cu(P_2O_7)_2]^{-6} \qquad \text{(A)} \end{aligned}$$

or

$$\begin{aligned} &Cu^{+2} + P_2O_7^{-4} \rightleftharpoons [Cu(P_2O_7)]^{-2} \\ &Cu^{+2} + 2P_2O_7^{-4} \rightleftharpoons [Cu(P_2O_7)_2]^{-6} \qquad \text{(B)} \end{aligned}$$

The decision between the two mechanisms can only be made provided the instability constants of the complexes present in the solution are determined. The instability constants of the complexes have been determined from optical measurements and the results will be published in the next communication.

My best thanks are due to Prof. P. B. Sarkar, Ghose Professor of Chemistry, University of Calcutta for his keen interest, helpful suggestions and all laboratory facilities during the progress of the work.

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REACTIVITY OF EXCHANGE SPOTS OF SILICATE MINERALS

THE acidity of a H-clay obtained by titration with an alkali is appreciably less than that obtained by titration with the same alkali in the presence of a high concentration of a neutral salt. Both the values of acidity depend moreover on the nature of the cation. The pH of an aqueous suspension of the acid-clay is lowered on the addition of a neutral salt and the acidity calculated from these pH values accounts for a fraction of the total acidity.[1] These observations suggest the existence of exchangeable H-ions in different states of reactivity.

Clays are known to possess crystalline layer lattice structures in which the exchange positions have also been envisaged. Exchange measurements are generally done with finely powdered samples having the sizes of the clay fraction of soil or even smaller. The crystal aggregates break on powdering mostly along cleavage planes but a simultaneous breaking along lateral planes also takes place. In the case of mica for instance, breaking along cleavage planes exposes K-ions on the surface whereas that along lateral planes develops what are termed "broken bonds" exposing Si and Al ions. Both these processes are responsible for the creation of exchange spots and in different minerals the exposed positions behave differently in ion exchange reactions. According to this picture even quartz should possess base-exchange properties. This has been verified in this laboratory.[2] Thus it is clear that at least three types of exchange spots are developed on powdering mica at (*i*) exposed K sites, (*ii*) broken bonds from Si ions appearing on the surface on grinding and, (*iii*) broken bonds from Al ions on the surface. Kaolin develops only the latter two types of exchange spots and quartz only the second type. The exchange spots developed on the lateral planes are evidently either weakly acidic such as at the Si-O-H spots or of doubtful acidity at pH's nearabout 7 such as at the Al-O-H spots, whereas the acidity developed by replacing exposed K-ions of powdered mica by H-ions is strongly acidic in character. The acidity developed by OH ions of cleavage planes of kaolin is also weakly acidic in nature. Marshall[3] states that the base exchange cations on the surfaces of clay crystals fall into two classes, those outside the clay particles which form part of the electrical double layer and those present in the spaces between the layer units of the lattice, where their environment is a comparatively intense electric field between negatively charged layers. Their behaviour in exchange reactions will not in general be identical with that of the cations external to the particle.

The differences between the reactivity of the exchange spots may not be apparent in the acid form

of the minerals, just as a mixture of weak acids will not give their individual inflexion points on potentiometric titration It was thought that exchange studies of the homo-ionic clay salts of the minerals by different cations may reveal the existence of different levels of affinity of the exchanged cations with the clay particles Earlier exchange isotherms were generally obtained using sufficiently high concentrations of the electrolytes at wide ranges of addition and possibly missed any characteristic fine features Experiments were therefore performed starting from very small concentrations of the added electrolytes and increasing by small amounts up to 4 times the symmetry concentration

A colloidal mica suspension was prepared by the wet grinding of a pure sample of it , montmorillonite from a sample of Kashmir bentonite , kaolinite from a sample of kaolin free from montmorillonite as indicated by the benzidine test [4] The clay fractions from each were separated by the usual procedure, then converted into the acid forms and finally into colloidal salts by addition of the requisite amounts of metal hydroxides [5] The exchange of cations from the clay salts was studied by adding the electrolytes at different concentrations, allowing not less than 10 days to attain equilibrium, and then separating the equilibrium solution by ultrafiltration or by centrifugation The clear equilibrium liquid was then analysed for either of the interacting cations and in some cases both In view of the small amounts of actions involved in the low concentration regions great precaution was taken to ensure accuracy in analytical estimations The following curves (Fig 1) were obtained then by plotting the percentage of cations exchanged against the concentrations of the added electrolytes, which were conveniently expressed in terms of symmetry concentrations Similar curves were obtained in a large number of such exchange reactions

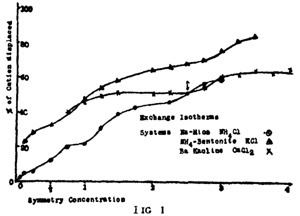

FIG 1

The curves show small but well defined inflexions, the existence of which was verified by repeated experiments The kaolinite shows one inflexion point whereas the mica and bentonite systems show two such inflexions These may be taken to indicate that exchange is taking place predominantly from two or three types of surfaces or from two or three types of exchange spots on the same surface Details will be published elsewhere

My grateful thanks are due to Dr S K Mukherjee, Department of Applied Chemistry, Calcutta University, for his continued interest in the work and for giving full laboratory facilities

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ON THE CONCEPT OF ENTROPY

THE concept of Entropy is fundamental in Thermodynamics It is a consequence of the Second Law that any change in the thermal conditions of a system results in increase of Entropy, which, therefore, tends to a maximum The universe is tending to a dead level of energy and all flow of energy will ultimately cease But it does not seem to have been fully realised that this is in direct contradiction to the concept of infinite time in the past It may be observed that the implication of infinite time is quite distinct from that of a long but finite spell of time such as one billion years

The new classical theory put forward by the writer[1] offers an escape from this inherent contradiction It envisages matter as composed entirely of electromagnetic waves coiled on a sphere

It is suggested that temperature is a property of matter in bulk and not of linear electromagnetic waves This is also supported by Maxwell's famous paradox of the demon, which can circumvent the Second Law by separating the fast moving gas molecules from the slower So if we postulate the primordial matter as existing in the form of electromagnetic waves, the question of temperature does not arise Also time would be at standstill in accordance with the Relativity Theory Creation began when the first particle was formed out of electromagnetic waves

and time began to flow It seems that there might be a substratum of truth in the picture of creation unfolded in the Book Genesis

This does seem rather fantastic, but I trust, not more so than the expanding universe But if the Relativity Theory be taken seriously and not only as a manner of speaking, there is no improbability The "ghost" stars of Relativity cosmogeny will then be invested with "bodies" New worlds are thus being created while old worlds are being annihilated Cosmic rays may be regarded as stray particles of the universe which have not got themselves in the tangles of large masses of matter

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20-12-1948

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A NEW COLORIMETRIC REAGENT

THE symmetrical diallyl derivative of dithiocarbamidohydrazine, $C_3H_5NH\ CS\ NH\ NH\ CS\ NH\ C_3H_5$, prepared easily by the interaction of hydrazine with allyl mustard oil, is a shining flaky, colourless and stable compound sparingly soluble in water, more soluble in organic solvents like chloroform and acetone The compound gives rise to deeply coloured complexes with palladous, cobaltous and bismuth salts which are highly soluble in chloroform and are therefore quantitatively extracted by the solvent from large volumes of aqueous solutions

The bismuth complex, a deep orange red compound having the composition Bi_2R_3 where RH_2 represents a molecule of the reagent, has been studied in some detail The optimum range of extraction with chloroform lies between *p*H 2·4—2·7 and is independent of the amount of reagent present in excess The variation of the orange colour with the concentration of bismuth follows Beers' law and has been verified by the Duboscq and Lumetron photo-electric colorimeters A minimum of 0·2 mg of the element in the form of the complex in 20 c c of chloroform can be easily estimated visually

A clean separation of bismuth from 1,000 times its weight of copper present in a mixture has been effected by extracting with chloroform a solution containing citrate and cyanide at a *p*H around 6

Details of the work will be published shortly in the *Journal of the Indian Chemical Society*

K P SEN SARMA
J GUPTA

National Chemical Laboratory,
University Buildings, Delhi,
and
University College of Science and Technology,
Calcutta, 10-1-1949

Sectional Presidential Addresses at the Indian Science Congress, Allahabad

Agricultural Sciences

Soil-Borne Plant Diseases and Their Control

R S VASUDEVA

ECONOMIC stability and prosperity of our newly constituted motherland is closely linked up with scientific growth and development of agriculture, and we in this connection have to play an important role in the work connected with it In India yields of crops are lower than on other countries even in normal times and are further depressed by diseases Losses on this account have been estimated in the neighbourhood of 10 per cent which can be averted by application of suitable control measures A considerable portion of such heavy losses is due to the soil borne pathogens and, in order to prevent these losses it is essential to obtain full knowledge about the life-history of the pathogens and their behaviour under controlled conditions, so that they may be attacked at weakest links in their life cycles The activity of a soil-borne pathogen forms only a part of the highly complex associations of living organisms, most of which are non-pathogenic and exert a profound influence on the parasitic activity of pathogenic organisms The conditions under which different soil-borne pathogens flourish are fairly wide, and soil aeration, temperature, moisture, reaction and available food material in the soil affect the activities of the organisms differently

Among the control measures devised to prevent losses caused by soil-borne pathogens there is no doubt that the most perfect method is the production of resistant varieties Rotation of crops, and sterilization of soil by heat and chemicals are neither always satisfactory nor practicable Biological control offers a good means of controlling such diseases Starving out pathogen or eliminating it altogether by enhancing the antagonistic activities of the non-pathogenic micro organisms has been found to be possible by modification of cultural practices or addition of certain manures Field sanitation is another control measure which is often neglected to the detriment of the cultivator Amendment of soil conditions such as temperature, soil moisture and reaction with a view to create unfavourable conditions for the pathogens have been tried with considerable success

The subject of soil pathology has gained importance during recent years and it having attracted attention of pathologists offers hopeful signs of solving the diverse pathological problem For a proper study of these problems team work of pathologists, soil-chemists, crop physiologists, geneticists and agronomists is what is imperatively needed to combat such maladies

Archaeology and Anthropology

Suggestions for Improvement in Methods of Dating

N K BOSE

INDIAN temples has been studied in the past by great workers like Ram Raz, Cunningham, Fergusson, Monomohan Ganguli, Havell and others Some of this work was systematic, some interpretative, and some historical Shri Bose has suggested some means for bringing in more precision into the usual methods employed for dating He has applied a current method of Cultural Anthropology in order to supplement the methods already in use in the field of architectural history

Shri Bose has described a method of structural analysis based on the canonical literature of Orissa By this means, the temples of North India can be subjected to a uniform process of analysis The temples of different provinces of India have been described on the basis of this method of analysis The Himalayan Region, Central India, Southern Deccan, the United Provinces and Orissa have been dealt with The distribution of certain structural elements have been noted in different portions of India On the basis of this regional analysis, and by comparing the areas of distribution, a relative time-scale for architectural elements has been provisionally

built up The picture of evolution of temples which thus emerges is substantially different from the results so far obtained by reliance upon other means hitherto employed

Shri Bose then suggests that, in each province of India, the *dated temples* should now be taken up and treated by the same method of analysis Scales of evolution will thus be available in each separate province by means of which the findings of the Distribution Method itself can be subjected to verification

Chemistry

Colloids in Biology and Medicine

P B GANGULY

COLLOIDS represent substances at a certain stage of minute sub-division and are generally composed of electrically charged particles, which are constantly moving and are possessed of scientific properties The characteristic properties of colloidal systems are manifested in numerous life phenomenon The applications of colloids to medicine and the utilisation of colloid-chemical principle for the proper understanding of many biological processes have been dealt with in the address

The investigations into the scientific basis for life has been a fascinating problem About 35 chemical substances have been found in living matter The most important constituent is proteins which according to the famous medical chemist Pauli possess those properties which in their totality represent life The material basis of life is the protoplasm, which is a colloidal system *par excellence* and obeys all the laws of colloids Life is no longer ascribed to the presence of any particular vital constituent but the living organism works in the simultaneous presence of all its constituents in harmony with its environments in accordance with known physical and chemical principles

Mineral inorganic substances were obtained as discontinuous periodic precipitates by Liesegang These experiments which were at first a laboratory curiosity were soon found to be remarkably akin to many natural formations Banded agate and various geological formations, shells of animals, bones, malignant growth like gallstones and other concretions in the animal body are stratified and are formed by the same colloid chemical methods which apply to Liesegang formations An interesting example is the formation of pearls in oysters The production of the pearl which consists of fine and regular striations is an accident, more an effect of disease in the oyster rather than any normal growth When grain of sand or other foreign matter enters the shell of the oyster, it causes irritation, as a result of which the oyster secretes a nacreous fluid which entraps calcium from sea water and deposits layer after layer round the foreign body until a full grown pearl develops By a colloidal process, the author succeeded in obtaining iridescent structures which exhibited the colour of the mother-of-pearl

Radiations have a great influence on colloidal solutions The behaviour of colloids towards light is linked with several branches of actino-therapy, chiefly in relations to deficiency and metabolic diseases Calcium salts are with difficulty assimilated in the body when directly administered, but their assimilation is greatly accelerated in the presence of certain vitamins which are synthesised by the action of light A photo-chemical basis is also noticeable in the colloidal properties of proteins on exposure to light

Adsorption represents a process by which molecules get fixed on suitable surfaces Adsorption plays a conspicuous part in many biological processes The mechanism of reactions on cell surfaces is similar to oxidation *in vitro* of organic substances on charcoal in presence of catalysts For digestion and many other processes in the animal body, the biocolloids known as enzymes come into play

Enzymes show all the properties of colloids and their action depend greatly on adsorption The reaction molecules get fixed on active surface and acquire a specified molecular architecture which is conducive to increased reaction In almost every sphere of biological activity, we find that predominant colloidal characteristics, like electrical charge on particles movement in an electric field, acidity of the medium, state of sub-division and membrane permeability, play a fundamental role Life is a continuance of the colloidal state and coagulation means death

Engineering and Metallurgy

Engineer's Role in Solving Socio-Economic Problems

M SEN GUPTA

THE address surveys in general, the requisite qualities of an engineer and his role in socio-economic problem confronting the country The present economic condition of our country with examples from the Bombay plan, where a statement has been made about the capital requirement necessary for doubling the income per capita per annum of our population have been dealt with As it is not possible to draw this capital from within the country without taking foreign loans which has got certain *objectionable features*, attention has been drawn to the potential qualities of personnel which can to a great extent compensate for the deficiency in capital outlay

Continuing Prof Sen Gupta emphasized the need for protection against avoidable errors and the urgency for thoroughness and extreme caution in planning out details of a scheme He cites a few examples in this connection and describes certain features of T V A and D V C scheme He then states the necessity of coordinated planning by the government, industrialists, engineers and economists and also points out that the technical education in our country should be remodelled Due to the absence of industrial background in our country, we cannot possibly produce technical personnel under different cadres required for industrial development and expansion merely by introducing certain modification at a university or college stage The entire scheme should be reviewed and revised starting from the primary school stage Without giving details, (which may be varied to a certain extent to suit local conditions) Prof Sen Gupta explains briefly the general ideas on which the education should be based and further draws up a skeleton scheme for technical education keeping in view the natural deficiencies that exist in our country The scheme has been drawn for supply of the technical personnel for the *future industrial development of the country* In this connection the writer emphatically points out the obligations of industrialists and factory owners in matters of training technical personnel in their different trades

Since the technical education has two distinct points, *viz*, (1) theoretical training in educational institutions and (2) to activise this theoretical knowledge from practical training in factories, therefore in any scheme of technical education which does not include these two main features is bound to be fruitless and non-productive It is, therefore imperative that the factory owners and industrialists should consider it obligatory on their part to afford necessary facilities for practical training which should be planned on a standard basis In doing so they will be merely discharging their duties to the community from which they are earning their bread

Medical and Veterinary Sciences

Some Aspects of Tuberculosis in India and Measures for its Control

M B SOPARKAR

DR SOPARKAR divides his address broadly into two parts The first part deals with those aspects of tuberculosis as it affects animals particularly cattle Unlike certain other diseases which are only experimentally transmissible, tuberculosis occurs as a natural infection principally in certain animals and birds The general impression for a long time has been that tuberculosis among cattle is rare in India Dr Soparkar's investigations made nearly twenty years ago have shown that the disease is very prevalent among cattle including cows, buffaloes and bullocks, in some parts of India, the incidence being equal or in some cases even greater than what is found in European countries where the disease is known to be prevalent Subsequent researches by other workers have fully corroborated these findings The general belief that buffaloes are more resistant than cows to infection has been found to be erroneous Several other animals of different species, *e g*, the Llama, spotted deer, Nilgai, Sambar, Antelope and others were found to be suffering from natural tuberculosis Dr Soparkar's experiments have shown that a proportion of India's calves are resistant to artificial infection with virulent tubercle bacilli in doses which invariably prove fatal to English calves. Contrary to the experimental evi-

dence adduced by Sheather, Dr Soparkar has shown that the tubercle bacilli infecting cattle in India are as fully virulent bovine type of bacilli as those infecting cattle in Europe Contrary to European and American experience he has shown Indian cattle to be infected under natural conditions with human tubercle bacilli He has also found them affected in nature with avian tubercle bacilli Swine in India also suffer from tuberculosis the infecting bacillus being pre-eminently human whereas in America it is pre-eminently avian type Horses, camels and elephants have also been found to be suffering from tuberculosis

In dealing with the surgical form of tuberculosis in children the address gives details of investigations made by Dr Soparkar and of the discovery of the bovine origin on the disease in two cases and avian bacillus infection in one case which has not been noticed elsewhere in India The address points to the desirability of close co-operation between medical and veterinary professions particularly in regard to research in tuberculosis The nature of the allergic reaction is also dealt with in this address so also is the filterable form of tubercle bacillus

In the second part which deals with the tuberculosis problem as it affects man in India details of the incidence of the disease in the country are given The ratio of tuberculosis deaths to cases is believed to be 1 to 5 which gives us the figure of 25 lacs of open cases in India at any given time The desirability of providing hospitals and sanatoria treatment for these cases and necessity of rendering the soil for the seed barren by appropriate preventive measures are dealt with The launching of mass vaccination with B C G is pointed out as an appropriate preventive measure Systematic work in Scandinavian countries has conclusively shown the value of B C G vaccination Other countries have also taken up the subject seriously The experience of over 10 million vaccinations with B C G up to 1945 in different parts of the world has demonstrated the safety of the measure and the protection it gives The Ministry of Health, Government of India have come to the conclusion that mass vaccination with B C G will be a cheap and effective method of reducing the incidence of tuberculosis assuming epidemic proportions The B C G vaccine is now being manufactured at King Institute, Guindy, Madras, and schemes are being formulated for the first introduction of B C G in some large centres in India Stress is also laid on the need for further research relating to the improvement of the vaccine and the method of administering it

Physics

Raman Spectra of Crystals and their Interpretation

R S KRISHNAN

ARE the vibrations in crystals which manifest themselves in the Raman spectrum "waves", extending through the volume of the crystal or are they the vibrations of the atoms in the individual cells of the lattice? Is the complete vibration spectrum of the crystal in the infra-red region a continuous diffuse spectrum or is it a discrete spectrum exhibiting a finite set of monochromatic frequencies? These are the specific issues which Dr Krishnan has sought to settle by experimental investigations stretching over the past 5 years on the Raman spectra of crystals He has described the modified ultra-violet technique of using the 2536 resonance radiation for exciting Raman spectra and the results obtained from a study of a large number of crystals like Diamond, Rock-salt, Alkali halides, Alumina, Topaz, etc The spectoroscopic facts unearthed have furnished a decisive answer to the above problems, *viz*, that while the spectrum of the elastic vibrations is necessarily a continuous one, the atomic vibration spectrum in the upper ranges of frequency is manifested in the upper ranges of frequency in the second order Raman effect as numerous closely spaced discrete and sharp lines, *i e*, we are concerned with the vibrations of the atoms in the individual cells of the crystal lattice These experimental facts fully justify the conclusions regarding the nature of the vibration spectra of crystals to which the new theory of the dynamics of crystal lattices put forward by Sir C V Raman leads

Statistics

Mathematical Procedure in Statistical Theory

U S NAIR

THE instinct to utilise past experience to formulate rules of conduct for the present and future is characteristic of human beings Statistical method is one approach to a systematic study of experience and inductive inference To give this technique a logical basis, it is axiomatically assumed that the totality of experience—past, present and future—constitutes an infinite set to which is associated a Mathematical Point Function called probability density A sample is a sub-set of the population and statistical analysis is directed towards the study of the density function from the known sample

The axiomatic definition of the density function brings out the interesting result contained in the Law of large Numbers and the Central Limit Theorem which relate to the behaviour of properties of the sample as it becomes unlimitedly great The constancy attained by the sample characteristic that results from the axiomatic assumption regarding density function is equivalent to the human instinct of inductive reasoning

The limiting laws referred to above lead to the Method of Least Squares as an important tool to the statistician The development of this technique in various types of situations is considerably facilitated by the Algebra of Matrices and Linear Vector Spaces

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Zoology and Entomology

Modern Trends in Systematics

M L ROONWAL

SYSTEMATICS is that ground-discipline of Biology which concerns itself firstly, with the orderly arrangement of the living world into a convenient and, as far as possible, natural system of hierarchical categories such as orders, families, genera, and so forth , secondly, with the distinguishing of one form or species from another, in the gamut of millions of species, both living and extinct , and thirdly, with the elucidation of the mechanisms by which these distinctions arise in nature Systematics is sometimes also called 'Taxonomy', a term which merely means the disposition of things in a rational and lawful manner

It was recognized early in the history of science that the lowest easily recognizable systematic unit is the species And the problem that framed itself in the minds of scientists was how to name these millions of living species so as to avoid confusion when mentioning one or the other This knotty problem was solved in the middle of the 18th century through the genius of the Swedish botanist, Linnaeus, who invented the 'binominal system of nomenclature' By international agreement, the following procedure finds universal acceptance (*i*) Within the same genus, one specific name can be employed for one species only, the name proposed earliest being the one accepted (rule of priority), so that one specific name can refer to one species and one only (*ii*) The 10th edition of Linnaeus's *Systema Naturae* published in 1758, is taken as the starting point for names of animals (*iii*) The specific and generic names are latinised, and are written in the Roman script

Later, when it was found that 'species' are not fixed but evolving, and that it is possible to recognize systematic units lower than the species, systematics was gradually transformed from a static into dynamic discipline The present address deals principally with the modern dynamic trends of development during the last 30 or 40 years The chief achievements of this period consist briefly of the following Firstly, a large number of intraspecific systematic categories have been recognized, such as subspecies, races, forms, varieties, pure-lines, and so forth Secondly, it is now clear that species are generally made up of a number of these lower groups or complex (form-groups, etc) Thirdly, modern systematics now plays a most significant role in the study of the mechanisms of 'speciation', by which term we mean those phenomena which are involved in the origin of new species and subspecies Among the most important of these mechanisms is the recently found statistical effect of population size on the intensity of speciation Thus, it has been shown that new species will arise most rapidly in a population which is of intermediate size and is divided into a number of smaller, partially isolated population-groups Lastly, the great practical importance of Systematics is discussed, and some suggestions are made for the future development of that discipline.

SCIENCE AND CULTURE

A Monthly Journal of Natural and Cultural Sciences

Vol 14 MARCH 1949 No 9

TELEVISION

ELSEWHERE in this issue we publish an article on *Post War Television* Of the many remarkable devices produced during the last few decades by the art of electronic control or "Electronics", few can equal the universal interest aroused by television Man now possesses the power of looking round the corner—power attributed to mythological gods alone in ancient time To the success of this seemingly impossible feat many scientists, inventors and engineers have contributed But it should be put on record that the first practical solution of the problem—however crude a solution it might have been—was due to the zeal and untiring perseverance of Baird The labours of Baird also showed the direction in which radical improvement was necessary to make television a practical proposition This radical change was introduced by Zworykin when he substituted the mechanical method of scanning by electronic scanning in his iconoscope or the "electronic eye" (1936) Improvements quickly followed which made the commercialisation of television service possible like broadcasting service And, even before the outbreak of World War II one saw television service established in England, U S A, France, U S S R, Italy, Germany and Japan The war naturally checked the progress But on the other hand, the war researches provided many new ultra high frequency techniques immediately utilizable in television Television service thus received an unprecedented impetus Further, as described by our contributor, applications of television technique have resulted in the invention of new ultra-rapid systems of tele-communication, new defence apparatus and new safety devices for aerial navigation It is therefore no wonder that the victorious countries are rapidly developing commercial television service and their expanding radio industries are spending lavishly on researches on new applications of television technique

It is strange that these phenomenal developments in the western countries are not generally known in India outside a very limited circle Even amongst people who ought to know better, the prevalent idea is that television is still in an experimental stage, that its service is uncertain and unsatisfactory and that, at best, it is far behind broadcasting in its usefulness and technical perfection There has thus been no comments either in the press or from the platform to impress upon the Government the necessity of taking steps for encouraging television research and for introducing television service in this country—at least as an experimental measure, as had been done by the B B C as early as 1936

Let us review the many uses of television besides the most popular one, namely, entertainment and dissemination of "live" news Television has immense possibilities as a means of spreading knowledge and stimulating thirst for the same in the young and the old Indeed, a more versatile and interesting system of instruction, in which the voice and the figure of the expert lecturer, in perfect unison with the actual demonstrations, are conveyed over hundreds of miles, can hardly be imagined In the hand of a Government, particularly of a large country like ours, television will be a powerful means—more powerful than simple sound broadcasting—of keeping people closer together in times of stress A popular leader's speech of appeal to the country will undoubtedly have a greater and more immediate effect if the audience not only hears the leader's convincing voice but also at the same time sees him delivering the speech with his characteristic pose and gestures of emphasis

A properly planned network of television service would enable the Government in times of emergency to arrive at quicker decisions on administrative and political matters through inter city television conferences To the business people it would provide an exceptionally effective means of commercial advertisement

TELEVISION SERVICE FOR INDIA

We have therefore no hesitation in urging upon the Central Government to take immediate steps for introducing television in this country by instituting

enquiry and sponsoring research for determining the best and the most suitable "system" to be adopted for India As explained in the article, each television service works on its own system A receiver designed and constructed for one system cannot be switched over to another system like a broadcast receiver being switched over from one wave band to another (A "system" comprises the number of lines per picture, the number of repetitions of pictures per second, the scanning method etc) A system once adopted cannot thus be changed without great financial loss For example, England having once adopted the definition of 405 lines per picture, is now finding it extremely difficult to change over to higher definition with increased number of lines, though such higher definition can easily be handled by the newly developed 'pick up' tubes A Committee of enquiry representing the various interests may therefore be appointed to make a thorough investigation on the various systems in use in the different countries, to compare their respective merits and the costs of the receivers, and to report on the same This, in fact, was done in Great Britain by the Selsdon Committee (consisting of representatives of the B B C, the Posts & Telegraphs, the Department of Scientific & Industrial Research and other bodies) before the television service was introduced in that country in 1936 Similarly, in the U S A the National Television Standards Committee (N T S C) was set up to decide upon the system to be adopted for the country The N T S C in its turn appointed a number of panels to investigate into the various aspects of the problem On the result of these investigations a report was submitted to the Federal Communications Commission and this was finally accepted as the standard for the U S A telecasting

Besides appointing the Committee the Government should also sponsor, through the Council for Scientific and Industrial Research, exploratory research work on the design and construction of television transmitter and receiver and on the various technical data of the system that may be adopted It may be mentioned here that both in England and in America large amount of experimental work was done before the problem of standardisation was finally solved There is also another very strong reason why researches on television technique should be instituted in this country Television techniques are being increasingly employed in designing new communication and defence apparatus And, it is highly undesirable that India should always be dependent on foreign countries for such new technical advancements

We therefore urge that on the report of the enquiry committee and on the results of investigations as suggested above, the Central Government should take steps for starting television service in this country A beginning can be made by installing television transmitters in, say three of the big cities like Delhi, Bombay and Calcutta Such service will, of course, not be a paying proposition in the beginning But such was also the case with radio broadcasting in the 'twenties The cost of the receiver will certainly be an important factor in popularising the service It is possible, however, to keep the cost within reasonable limits by suitable design It is to be noted in this connection that building of television components can without difficulty be made part of the production programme of the radar and radio industry which is going to be started under the auspices of the Government of India, and it may be possible, by suitable designing, to manufacture television receivers locally at reasonable cost so that it may be within the reach of the prospective televiewer

RADIO RESEARCH AND NATIONAL SECURITY

"Today, with the world praying for peace, we find ourselves in completely new areas of thought and action We must keep these changed conditions constantly in mind as we plan for the future It is of extreme importance, as we apply the new developments of radio and electronics to peacetime pursuits, that we do not lose sight of the continued relationship of science and industry to our national security Radio research and invention, and every new instrument should be constantly evaluated to determine their application to the strength and security of our country as well as to its commercial progress "

—David Sarnoff, *President of the R.C A.*

POST-WAR TELEVISION*

MRINAL KUMAR DAS GUPTA

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TELEVISION or the art by which one can see at a distance even when the direct line of vision is obstructed, made remarkable progress during the closing years of the last decade Regular television service was inaugurated in Great Britain, in the U S A, France, Germany, U S S R and Japan Unfortunately the outbreak of World War II diverted the scientific resources, both in men and material, to war researches and seriously checked the progress However, many of the developments in the field of radio, particularly those in the very high frequency and microwave regions made during the war are directly utilisable in television technique As such, television has received a fresh impetus as soon as the war has been over It is now a fully commercialised service and is not to be regarded as an experimentaltoy This has been amply demonstrated by the great success with which the B B C televised the Olympic games, by the part it played in the last presidential election campaigns in the U S A and last, but not the least, by the installation of a television receiver at 10, Downing Street, London, the official residence of the British premier Television is now a practical medium of entertainment, instruction and dissemination of news

In the present article a brief survey will be made of the developments of television service made in the different countries after the war, of the technical progress made during and after the war and of the possible future developments

Progress in Television Service

Immediately before the war, England was the leading country in television service Unfortunately the progress was stopped and she is now again trying to pick up the lead British television employs 405 lines and is under the control of the B B C There is one powerful transmitter at Alexandra Palace for the London area Free television demonstrations are given in the Science Museum, South Kensington everyday Another transmitter at Birmingham, near Sutton Coldfield is nearing completion This new station will be interlinked with the existing London Station by two relay stations. Each of these relay stations

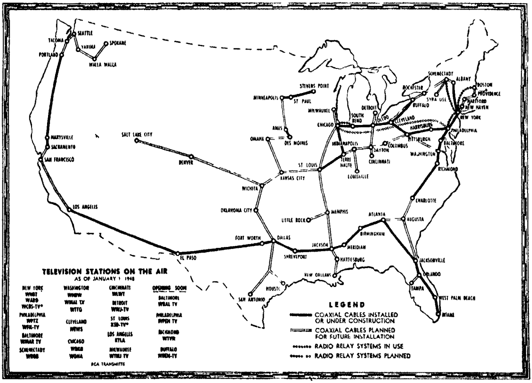


Fig 1 The existing and the contemplated network of television services in the U S A —(From *Radio Age*)

* The article is based on a talk given by Prof S K Mitra at the Rotary Club, Calcutta, on December 14, 1948

consist of an 80 ft lattice steel tower on the top of which will be a 9 ft square cabin containing R F and signal channel equipment The transmitting and the receiving paraboloids each 12 ft in diameter, are to be mounted above the cabin The power supply, and the control equipments are housed in a small building at the base of the tower

The increasing popularity of television service will be evident from the fact that while at the end of 1947 the number of licences was only 18,850, that at the end of 1948 was 52,500 The number at the end of 1949 is expected to reach 100,000 mark

French television is worked by the P T T authorities on 455 lines per picture At present programmes are radiated 5 days in the week There has also been proposals for extensions of television service into the principal towns like Lille, Lyons, Toulouse, Marseilles and Bordeaux The new services are expected to adopt higher definition—819 lines Attempts are being made to erect television theatres in certain towns where large audience will be able to see big screen reproduction of the 819 lines transmissions A link between the British and French television for interchange of programmes is also contemplated

Russia is also not lagging behind Besides the existing stations at Moscow and Leningrad two more powerful stations will be opened in the near future Russia works on 625 line system But a high definition is being contemplated

Television has made the greatest stride in the U S A She is now the leading country for television service in the world There are at present 31 television stations operating in the U S A An estimated 360 more stations are in the various stages of preparation subject to the approval of the Federal Communications Commission Television receivers are being manufactured at the rate of a million a year as against 8,000 a year, a year ago The usual service area of a television transmitter being 50 to 60 miles, a country like the U S A has to be served by a network of stations interlinked with each other by cables or radio relays Comprehensive plans have been prepared and construction programmes undertaken for the network system (Fig 1) The existing stations together with the contemplated network systems will provide the U S A with television service entertaining millions of audience

Besides the above mentioned countries, Australia, Canada and Poland are also planning for immediate installation of the television service Of these, Australia has already advanced much in her plans Her capital towns will soon have their television transmitters

Technical Progress

Advance in television technique made since the introduction of electronic system of scanning by Zworykin in 1936, has mainly been in two directions, namely, in the development of sensitive "pick up" tubes as can be used with ordinary room illumination and in the production of large size television pictures suitable for a public audience Other notable advances are, efficient network system for interlinking distant cities (cables and radio relays), higher definition, mobile equipment for telecasting topical events These are briefly described below

(1) *Pick up tubes* The "pick up" tube is the heart or rather the eye of television transmission apparatus It performs the function parallel to that of the microphone in sound broadcasting The microphone converts fluctuating sound into corresponding fluctuating electrical impulses The television pick-up converts the fluctuating brightness—the light and the shade values of the different parts of the scene to be televised—into their electrical counterparts This it does by scanning the scene line by line in a small fraction of a second during which the scene has not changed appreciably (Fig 2) The original devices for performing this scanning were mostly mechanical But a new principle was introduced in 1936, by Dr Zworykin in his *iconoscope* in which the scanning was

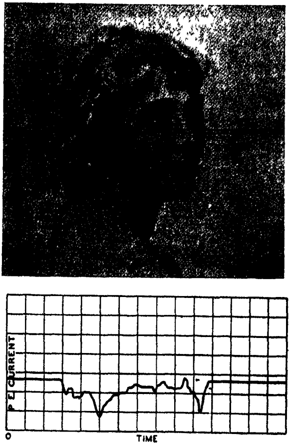


Fig 2 Illustrating the scanning operation The picture is scanned by dividing it up into a number of very narrow adjacent strips Here a particular line is taken and the electrical fluctuations corresponding to the different light and shade values are represented in the graph shown below —(From *Television Today*).

done entirely by electronic method enabling pictures of much higher definition to be produced

The action of the iconoscope or the "electronic eye", as it may be popularly called, closely resembles that of the eye in its behaviour It consists essentially of a lens functioning like the lens of the eye and of a mosaic of minute photoelectric cells which may be compared to the retina The lens throws the image of the scene to be televised on the mosaic and forms on it by photoelectronic stimulation an electrical image of the optical scene This electrical image is scanned by a beam of electrons line by line, from top to bottom and in the process electrical impulses corresponding to the light and shade values of the different parts of the scene are generated and conveyed to the transmitting system (See Fig 3)

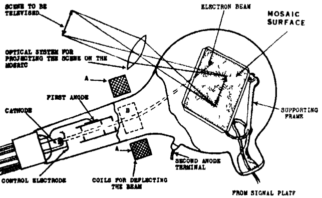


Fig 3 Iconoscope or the "electronic eye" The electrical image of the optical scene formed on the mosaic surface is scanned by the narrow beam of electrons The current fluctuations or the "video" signals corresponding to the light and shade values of the different parts of the scene, are conveyed to amplifiers and are made to modulate the carrier wave (From *Television Today*)

The iconoscope, however, suffered from a grave defect from the practical point of view The scene to be televised had to be very strongly illuminated which was rather inconvenient The iconoscope principle has, however, been suitably developed and new pick up tubes produced, with which it is now possible to televise scenes under ordinary room illumination

The low efficiency of the ordinary iconoscope is due to the fact that in it only a fraction of the electrons liberated from the mosaic contribute to the production of the signal A very strong illumination of the object is thus necessary to get a satisfactory signal-to-noise ratio Another defect of the iconoscope is that the uncollected electrons due to secondary emission fall back on the mosaic and cause a shading of the picture These defects have been eliminated in the new pick-up tubes—Image Orthicon (RCA) and C P S Emitron (E M I, Great Britain) With these pick up tubes scenes even under ordinary room illumination can be picked up and transmitted

The construction of the Image Orthicon is shown in Fig 4 Its principle is as follows The optical image is formed on the photocathode which is at a potential of −600 volts The photoelectrons produced are focussed by means of the magnetic focussing coil on to the target electrode which is at zero potential The target electrode is of extremely thin low resisti-

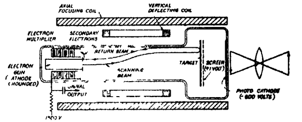


Fig 4 Sensitive pick up tube—Image Orthicon The high sensitivity is due to the fact that the electron multiplier system at the output, in addition to the photo cathode, target electrode and the aperture electrode, all introduce several stages of electron multiplication The screen attracts the secondary electrons emitted from the target electrode and thus eliminates the shading effect (From *Proc I R E*)

vity glass and has a high secondary to primary ratio More secondary electrons are thus emitted from the target electrode which are then attracted to the screen placed a few thousandth of an inch distance from the target (The screen is at a potential of +1 volt) A charge pattern corresponding to the original optical image is thus formed on the target electrode The scanning beam accelerated by the anode is slowed down as it approaches the target As the charge pattern is scanned, the beam loses appropriate number of electrons to neutralise the electron deficiency on the target electrode this loss being proportional to the original optical intensity The rest of the electrons in the beam, return as shown in the return beam and strikes the aperture electrode The intensity of the return beam is evidently modulated as the scanning operation goes on The aperture electrode is followed by the electron multiplier system, the output of which constitutes the signal output The high sensitivity of Image Orthicon is thus due, firstly, to the photocathode being more effective in the liberation of photoelectrons than the mosaic surface and secondly to the target electrode, as also the aperture electrode together with the electron multiplier system, introducing several stages of electron multiplication

(2) *Projection Television* A great drawback of ordinary television receiver is that the image formed on the screen of the cathode ray tube is small This is because the size of the tube cannot be made large for reasons of mechanical strength Even in the most expensive receiver the size does not exceed 9 inch by 12 inch (Fig 5) To see the small figures moving and to hear them speaking and singing with the full loudness of human voice produces an unnatural impression Further, such small pictures are useless for entertaining a large audience The problem has been solved to a great extent by making the pictures on the cathode ray tube screen highly brilliant by using high anode voltage and then projecting an enlarged image by a

suitable optical system The principle of the projection system which has been employed successfully is quite simple being just the reverse of Schmidt's optical method of photographing the stars In Fig 6, K is the cathode ray tube of the receiver, A is the

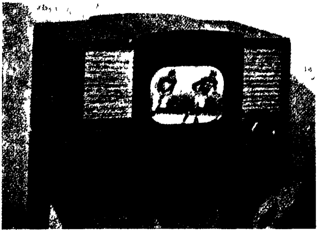


Fig 5 A modern table model television receiver The received picture is of size $6\frac{1}{4}'' \times 8\frac{1}{4}''$ —(From *Radio Age*)

anode connection, S focusing and deflection coils, M_1 spherical mirror, C Schmidt correction plate which eliminates the effect of spherical aberration The receiving screen (not shown in the diagram) is at a comparatively large distance The emergent rays are therefore drawn parallel The picture on the cathode ray tube which is small but is made very bright by use of high anode voltage is thus projected suitably on the viewing screen

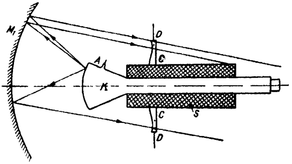


Fig 6 A simple optical system used in large screen projection of television pictures M_1 is the spherical mirror which produces an enlarged image of the picture on the screen of the cathode ray tube K C—section of Schmidt correction plate for elimination of spherical aberration, A—anode connection S – focussing and deflection coils The projection screen, at a larger distance, is not shown in the diagram —(From *Philips Tech Rev*)

A modification of this method has recently been made in the Philips Laboratory A plane mirror M_2 is used in the light path between the spherical mirror and the correction plate (Fig 7) This insertion eliminates the lateral shadow effect obtained in the previous method The sizes of the mirrors and their positions with respect to the correction plate determine the ultimate brightness and the magnification obtained in the system In one method, employing

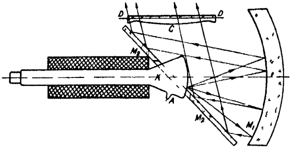


Fig 7 Improved Philips optical system for 'Projection Television' A plane mirror M_2 is placed in the light path between the spherical mirror M_1 and the correction plate C The plane mirror makes an angle of 45° with the axis of the cathode ray tube and eliminates the lateral shadow effect —(From *Philips Tech Rev*)

Schmidt's system with $3\frac{1}{2}$ inches cathode ray tube and 14 inches optical system, the magnification obtained was 7 5 times at a throw distance of 69 inches Plastics is preferred to glass for the optical equipment since the cost per lens is less and large apertures with less aberration can be easily obtained with it

R C A have recently developed a Schmidt type optical system by which pictures of high quality 18×24 feet can be obtained This new projector utilizes a 15 inch cathode ray tube operating at 80 Kv and an optical system employing 42 inches spherical mirror and 36 inches aspherical correcting lens The projection distance or the "throw" of the equipment is 40 feet This is now the largest Schmidt type optical system producing pictures large enough for cinema show

A rather indirect method of producing large pictures for cinema projection, having great commercial possibilities, is the intermediate film method In this method the picture on the cathode ray tube screen is focussed on a photographic film which is developed, fixed and then passed through a projector—all in less than 60 secs Projection on to a screen 12 ft by 10 ft is as good as that of 16 mm Cine

Such television projectors working in close cooperation with the cinema show would no doubt help much in producing better programmes A convention was held in Paris in October, 1948 organised by the Société de Radioélectriciens on the question of relation between television and cinema

(3) *Improvements in Definition* The number of lines used for scanning determines the definition or the amount of detail that can be obtained in the picture (See Fig 2) In the first B B C television broadcast (1929) employing mechanical scanning system the pictures were split up into only 30 lines The

detail was naturally very poor With the introduction of electronic scanning system there was great improvement and high definition television service using 405 lines was first started at the Alexandra Palace station in 1936 With this new system 14 times more details of the picture could be transmitted as compared to the old system Still higher definition is being aimed at and the various countries are trying to increase the number of scanning lines Americans use 525 lines per picture and are experimenting for higher definition The French employ 455 lines and new systems using 819 and 1029 lines are being experimented on The Russians use 625 lines It is interesting to note that the figures given above are all odd This is because of technical reasons, the number of lines has to be multiples of odd numbers below 11 The standard of definition, i e of number of lines has to be carefully fixed, because any change in this standard makes the receivers useless, it being extremely difficult to adapt them to the changed number In this connection it may also be pointed out that no international standard of definition has yet been fixed Such a standard is, however, essential for exchange of programmes between different countries A common standard is also necessary from the commercial point of view

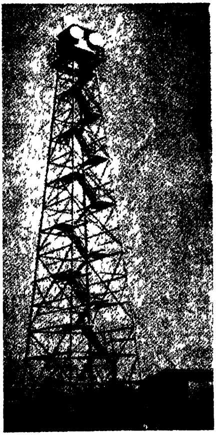


Fig 8 A modern radio relay station The cabin above the steel tower contains the R F and other equipment The transmitting and the receiving paraboloids are also shown The power supply units and the control equipment are housed in the small building at the base of the tower —(From *Radio Age*)

(4) *Television network system* For television transmission very high frequencies in the range of wavelength round 6 meters have to be used This is because the *video* signal, *i e* the electric impulses corresponding to the light and shade fluctuations of the scene to be transmitted, has a frequency ranging up to 5 Mc/s The carrier frequencies employed for radiating the video signal must therefore be at least 40 Mc/s Unlike the longer waves used for sound broadcasting, waves of such high frequency have very short range It is thus not possible to provide worldwide or even countrywide television service from a single transmitter One transmitter can serve, at best one city with its suburban areas This obviously is a serious handicap to the usefulness and popularity of telecasting The inhabitants of one city naturally want to see the important events of another city, particularly those of the capital city The problem has been solved by interlinking the cities which want to exchange programmes by special cables or radio relays.

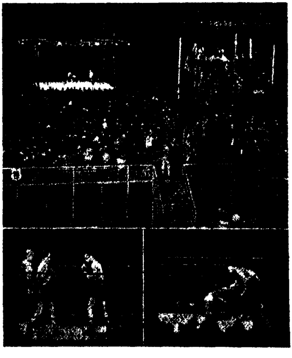


Fig 9 Televising a boxing competition (left corner at the top). The camera equipments are placed on the platform at top right The actual pictures as seen on the receiver screen are shown at the bottom —(From *Radio Age*)

The former, is just a pipe with a wire down its centre The *video* signals can be pumped through such pipe over many hundreds of miles. The latter, radio re-

lays, are installed at suitable intervals (average distance 30 miles) between the cities to be interlinked The function of the relay is to catch the signals from one station and to transmit them after suitable amplification to the next relay This in its turn re transmits it to the next one and so on till the destination is reached Fig 8 shows a modern relay station It should be mentioned that both cables and relays are very expensive

(5) *Mobile units for topical events* Telecasting of topical events is a very popular item of television service (Fig 9) And, of all the topical events, televising of sports is perhaps the most popular As such, many technical devices have been invented to televise sports with success To televise a foot ball game, for instance, use is made of an air conditioned sound proof truck on the top of which stand two or three camera pick-up tubes each with its own operator surveying the game The operator can shift instantaneously from a player kicking the ball to a close up of the soaring ball with the help of a device called a "Zoomar" on one of the cameras A second truck houses the control equipment with its operators and the director who can control with swift precision and edit the images going on the air The commentator sitting in the camera cage watches the game as well as a master screen and speaks before the microphone (Fig. 10)

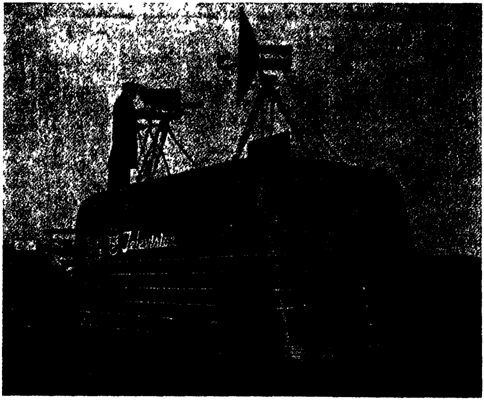


Fig 10 A modern mobile unit employed in televising outdoor events The cameraman is seen adjusting the 'Image Orthicon' pick up tube The transmitting paraboloid is on his right —(From *Broadcast News*)

New Developments

The research laboratories of many of the universities and research institutes as also those of the big industries in the Western countries are now carrying on intensive research for further improvement of television service and also to find new fields of application of television technique Some of the new and prospective developments are briefly described below

Long distance transmission of television signals with radio relay or cable is very expensive A method of obviating this is being experimented upon by the Westinghouse Electric Corporation by what they call *Stratovision* Instead of building higher and higher relay towers, transmission is made from high flying aeroplanes Ground studios beam programmes to the planes at about 30,000 ft These relay the programmes to receivers within an area of 211 miles radius With such a system it is possible to serve 78 per cent of the U S A with only 14 planes at the estimated cost of $1000 per hour. Stratovision in this

or some other form, if perfected to the point of commercialisation, would certainly make a great advance in diffusion of television programmes

Another possible development is the combination of ordinary telephone service with television As far back as 1936 the German Postal authorities were experimenting on the same between Berlin and Leipzig with a special cable system It was reported that the system worked successfully, though of course it needed many improvements for full commercialisation Television linked with telephone will, no doubt, be very useful particularly in the business world

Researches are being carried on in respect of colour television Colour television systems are based on the principle that any colour can be obtained as a combination of three primary colours—red, green and blue Two methods are generally used for the production of pictures in natural colours—the *sequential* and the *simultaneous* method

In the *Sequential Method* use is made of filters—red, green and blue, both at the transmitter and the receiver When the transmitter filter 'sees' blue, for instance, control signals are sent out which actuate the blue filter at the receiver end Blue colour is thus imparted in proper places to the received picture With the colour filter acting in proper sequence therefore, the colours as seen at the transmitter are reproduced on the receiver screen

In the *Simultaneous Method* three separate photo-sensitive surfaces are used in the pick up arrangement The three components—red, green and blue—are separately focussed on these surfaces through respective filters and are scanned simultaneously The outputs from each of these pick-up tubes are then transmitted on separate channels In the receiver side three cathode ray tubes are viewed through the three different filters The combined action of the filters and the respective phosphors of the receiver screen impart the respective component colours on the screens The three separate coloured images are then combined optically in proper sequence on the final receiver screen reproducing the original scene in its natural colours

Though not commercialised, colour television has been an experimental success The reception of the original scene in its natural colour is certainly an added attraction as it contributes much to the reality and the brilliance of the picture However, the drawback of colour television is that the receiving sets would be too expensive for common use

A remarkable application of television technique in high speed tele communication should also be mentioned This is *Ultrafax* system developed by the joint effort of the R C A , the Eastman Kodak Company and the National Broadcasting Company of the U S A It is capable of transmitting and receiving written or printed messages and documents at the rate of a million words a minute This remarkable result has been achieved by a combination of modern television process with the latest techniques in radio relaying and high-speed photography The operation consists of the following steps Firstly, the matter to be transmitted is so arranged as to ensure a continuous flow at high speed This is then scanned by the flying spot television scanner and the televised image is transmitted as ultra high radio frequency signals over a microwave relay system Projection type television receivers are used to receive the incoming messages, which are then recorded on motion picture film or on to a photographic paper The exposed film can be transferred quickly to a special processing unit developed by Kodak Research Laboratories where it is rinsed, fixed and dried in less than half a minute The film may be enlarged to full sized copy by means of a high speed continuous processing machine and any number of Ultrafax messages can be printed from a single film In a demonstration in October 1948 before the Library Congress, Washington, D C , the 1047 page novel "Gone with the Wind" was transmitted and received in about two minutes It has been said that "Ultrafax is as significant a milestone in communications as was the splitting of the atom in the World of Energy"

Mention may also be made of *Teleran*, developed in recent years by the R C A engineers working in collaboration with the U S Air Forces The new invention is a combination of the modern radar and television techniques known as *Tele*vision-*Ra*dar *N*avigation, or in short Teleran Teleran scope fitted on the instrument panel of a plane can give its pilot all the necessary information regarding its position and the terrain below In actual operation the information regarding the position of the plane is collected by ground radar stations which is then televised along with the terrain map The pilot sees on his receiver screen a complete picture showing all the details of the terrain below with the necessary route markings, weather conditions and finally his position in space

Concluding Remarks

As has been mentioned earlier, television is no longer an experimental toy but a fully commercialised service in all the advanced countries of the world Television research now forms an important item in the research programmes of the principal research organisations of these countries These researches have found novel applications of television technique in many useful fields Progressive thinkers of all countries in the world now well realise its potentialities It is, however, regrettable that India is one of the very few independent countries which is doing nothing in regard to television service or research in this Age of Television It is a pleasure to recall in this connection that televison study and research has been included in the curriculum of the newly opened Department of Radio Physics and Electronics of the University of Calcutta. Let us hope that our National Government will soon take active interest in the matter and take steps for instituting television service and research in this country

UNORTHODOX RADAR VISION

FLT LT K R SAHA
METEOROLOGIST, R I A F

THE use of the ultra short wave radar to detect coastal areas and low lying surface targets during World War II brought to light numerous instances of objects being detected or followed at distances far beyond the optical horizon Reports of such unorthodox radar vision came from almost all parts of the globe and the phenomenon was found to be related to the weather and climatic conditions To give only a few examples of unorthodox radar visions, (1) A 10 cm Coastal Defence Radar set at Steamer Point on the south coast of England saw the French coast at a maximum range of 170 km on many days during the period 5th to 26th July, 1944, when the normal range expected would have been 40 km , (2) a 255 ft station at Bombay, optical horizon 20 miles, frequently picked up on its 1½ metre radar set during February and March, 1944, ships at distances of more than 300 miles out at sea and occasionally saw the Arabian coast at distances of 850 1500 miles and even the shore of the Gulf of Aden at 1700 miles, (Fig 1), (3) a 1½ metre early warning radar

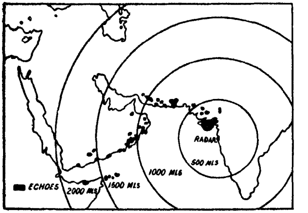


Fig 1 Long range fixed echoes seen by 1½m early warning radar at Bombay (255 ft above sea level) during February and March, 1944

sited on a 184 ft tower at Diamond Harbour in Bengal, optical horizon 18 miles, saw objects at a distance of 200 miles on a night in March 1944, when the daytime vision was limited to 40 miles, (Fig 2), (4) a 6000 ton vessel in New Zealand waters was followed by a high powered centimetric radar from a 625 ft station to a distance of 120 miles and then lost off the time base, the signal strength then being 16 decibels above noise The distribution of the receiver signal strength as the vessel receded from the station is shown in Fig 3, which shows that while the range of normal orthodox vision for the vessel was 30 40 miles, the propagation on this particular occasion was markedly unorthodox

The examples quoted above are typical of the phenomenon that was widely observed during the war and it created widespread interest among radio physicists As already mentioned, the phenomenon was found to

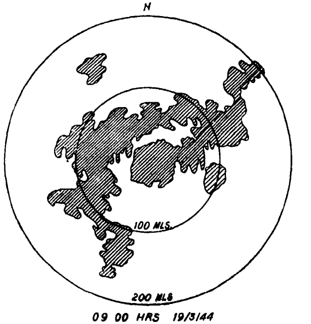
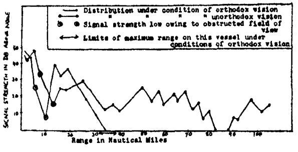


Fig 2 Diurnal variation of fixed echoes for 1½m early warning radar on 184 ft tower at Diamond Harbour, Bengal

Distribution under condition of orthodox vision
" " " " unorthodox vision.
Single strength low owing to obstructed field of view
Limits of maximum range on this vessel under conditions of orthodox vision

be directly influenced by meteorological conditions Intensive research soon revealed that unorthodox radar



Range in Nautical Miles

Fig 3 Distribution of signal strength from a 6000 ton vessel in stern aspect taken in a high powered centimetric radar sited at 625 ft a.s.l (after Alexander)

vision was caused by the formation of so-called radio ducts due to atmospheric super refraction. Super-

refraction is caused by the existence of abnormal gradient of temperature and humidity It is well known that under normal conditions throughout the troposphere, temperature decreases with height with a lapse rate of 3 47°F per 1000 ft If for any reason there is an increase of temperature with height or a "*temperature inversion*" as it is called, appreciable super refraction is likely to occur Vertical distribution of moisture plays a more important part in the phenomenon Ordinarily humidity diminishes with height at a standard rate Too large a lapse rate of humidity gives rise to pronounced super refraction It has been observed that a temperature inversion of 8°F and a humidity mixing ratio deficit of about 5 gm/Kgm in the lowest 1000 feet of the Earth's atmosphere can produce marked super refraction In other words super refraction is observed when the upper air is sufficiently warm and dry compared to the air close to the earth's surface Humidity control increases with the temperature of the air It is for this reason that the phenomenon of unorthodox radar vision is more pronounced in tropical regions like India, Malta, etc Progress in the study of this phenomenon has recently led to the development of a new science called Radio Meteorology on which work is still continuing The object of this article is to outline our ideas as to how super refraction explains unorthodox radar vision in the lower atmosphere and briefly discuss the meteorological origin of super refraction

Atmospheric Super Refraction— Formation of Radio Duct

Radio refraction in the atmosphere was known long before war But an impetus to the study of radio refraction came only in war time when both radio scientists and meteorologists were called upon, to explain the new phenomenon of unorthodox radar vision Due to the refracting property of the atmosphere a radio ray starting horizontally from a transmitter is bent away from the upward vertical and has a tendency to follow the curvature of the earth In a well mixed atmosphere in which turbulence maintains a fairly normal distribution of air, it is shown that the radio ray has a curvature of one fifth of that of the earth A ray curvature of this amount will probably be produced in any atmosphere if the transmitter is sited sufficiently high in the atmosphere But the refractive index gradient is seldom uniform throughout the height of the atmosphere Especially in the lower layers, the refractive index gradient departs far from normal at times, depending upon meteorological conditions Within a layer of 100 ft or so above the ground, marked lapse rate of refractive index occasionally results from steep negative gradients of air density and humidity In such a heterogenous atmosphere, if a transmitter is brought downward from a high level, a radio ray will be refracted more and more until at a critical height it will have the same curvature as the earth and thus continue to maintain its height round the earth instead of flying off at a tangent. This critical height marks the top of what is known as a Radio duct If the transmitter is taken below the critical height, a radio ray will have greater curvature than the earth It therefore, strikes the ground obliquely and after being reflected from there proceeds on its journey by successive reflection at the ground inside the radio duct The radio duct thus traps the radio ray completely and guides it round the curved earth The energy of the ray thus trapped is maintained over a fairly long distance and can proceed well below the geometrical horizon This explains how super refraction in the lower atmosphere guides the radio energy in the radio duct and causes unorthodox radar vision Fig 4 shows schematically the formation of the radio duct and the propagation of a radio ray below the geometrical horizon by successive reflection at the earth's surface or the lower surface of the duct T_2 marks the position of the transmitter at which the ray has same curvature as the earth

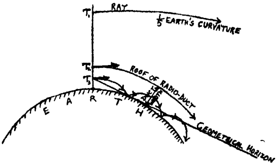


Fig 4 Formation of Radio Duct

Unorthodox radar vision was observed at metre, decimetre and centimetre wave lengths only Radio propagation at broadcasting wave lengths was found to be completely orthodox even in an atmosphere with marked super refraction What is the cause of this dependence of super refraction on wave length? The variation of the refractive index of the atmosphere with wave length may be considered to be negligible for the range of wave lengths under consideration and cannot, therefore, explain this dependence of super refraction on wave lengths The explanation given by the wave theory is that an atmospheric duct is a wave guide and as such will only transmit efficiently waves whose length is below a certain value related to the width of the duct The longer the wave length we wish to transmit, the larger the duct width must be before efficient guiding can occur It was shown by Eckersley that a duct-width of the order of 16000 ft is required to transmit efficiently waves of length 1 km, whereas a duct-width of 100ft is sufficient to guide efficiently waves of length 10 cm Duct width of the order of 16000 ft is never observed in the atmosphere, a fact which explains the complete independence of long radio waves of super-refraction On the other hand duct-width of the order of 100 ft or so occurs frequently in the lower atmosphere and as a result short radar waves are transmitted in the wave guide far beyond the geometrical horizon,

This dependence on wavelength of the unorthodox propagation of wave has been illustrated in Figs 5(*a*, *b* & *c*) Fig 5(*a*) shows the case of sufficiently short wave when complete trapping of rays by the duct is possible Fig 5(*b*) indicates partial trapping in case of waves of medium lengths Fig 5(*c*) shows the case of long wave when the wave passes out completely untrapped

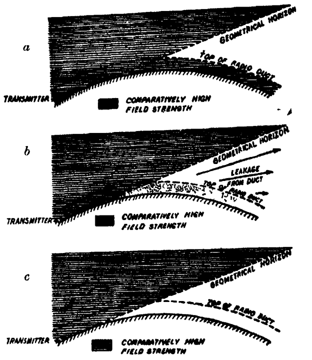


Fig 5*a* Illustrating trapping by a duct (sufficiently short waves) —Comparatively high field strength

Fig 5*b* Illustrating partial guiding by a duct (transition from super refraction to orthodox propagation) —Comparatively high field strength

Fig 5*c* Illustrating practically no guiding in spite of duct (sufficiently long waves) —Comparatively high field strength

Meteorological Origin of Super-refracting Layers

Refractive index of atmospheric air for radio wave is given by

$$\mu = 1 + \frac{79}{T}\left(p + \frac{4800}{T} e \right) \times 10^{-6}$$

where T = temperature in °K, *p* the pressure, and *e* = the vapour pressure in millibars

A more convenient quantity is the Modified Refractive Index (M R I) defined as

$$\mu' = (\mu + h/a - 1) 10^6$$

where a=radius of the earth and h=the height above the ground level Ordinarily μ' increases with height at the rate of 36 μ' unit per 1000 ft Existence of a temperature inversion and an appreciable negative humidity gradient, however, gives rise to a decrease of the M R I with height An atmospheric layer with negative μ' gradient is, therefore, the seat of a radio duct A refracting layer of the type depicted above need not necessarily begin from the surface of the earth The layer might as well be elevated above the earth's surface depending upon the distribution of temperature and humidity This gives rise to several distinct types of radio ducts Fig 6 shows the three principal types of atmospheric profiles which give rise to super refracting layers or radio ducts in the atmosphere The series of figures under (*a*) shows the case when the negative gradient commences from the surface of the earth In this case the refracting layer and the radio duct rest on the ground Such ducts are called the Surface layer and Surface duct type or the SS Ducts These are of the most important type Distribution shown under (*b*) gives rise to a refracting layer somewhat elevated above the ground but, nevertheless, the duct rests on the ground Such ducts are called the Elevated layer Surface duct or the E S Duct These are of less importance than the S S Ducts and are associated with large temperature excess and humidity deficit of the upper air Distribution depicted in (*c*) gives rise to a refracting layer and a duct both elevated above the ground Such ducts are called the Elevated layer Elevated duct or the E E Ducts These are only of minor importance

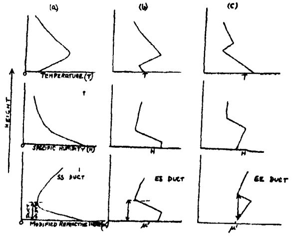


Fig 6 Types of Radio duct (after Booker)

Temperature and humidity distributions in the upper air affecting radio-ducts have recently been investi-

gated experimentally by aircraft ascents and by meteo rograph flights using a captive baloon In the British Isles, planned experiments by these methods over the Cardigan Bay have yielded a valuable set of data on which researches are still in progress Recently a party of T R E scientists came to Malta to collect data on super refraction Similar experiments are being con ducted or planned for other parts of the world Data so far investigated seem to support the theoretical considerations outlined in this article but further data are, of course needed for a detailed study As a result of the investigations so far carried out it is now known that the meteorological conditions which build up super-refracting layers in the atmosphere are caused principally by the following

1 Radiative Cooling over land

Under clear sky conditions especially when an anti cyclone prevails, the ground radiates and cools result ing in a temperature inversion Usually there is a negative humidity gradient to start with but if the temperature on the ground falls below the dew point, water vapour is removed in the form of dew drops, and the negative gradient may be reversed The effect of the temperature inversion may then be offset by the positive humidity gradient and as a result the radio duct is liable to be destroyed

2 Subsidence

Under anti cyclonic conditions, air settles down from quite high levels As a result of downward mo tion into regions of higher pressure the temperature of the settling air rises adiabatically Since the air has descended from high levels, it is dry and spreads out as a dry warm layer over a cooler moist layer This type of inversion may occur over both land and sea and at any time of day or night Subsidence usually gives an elevated duct of the type of ES or EE Duct

3 The Sea breeze

The intense sea breeze effect in some parts of the world offers a favourable condition for marked super refraction in the atmosphere, specially if the air current above the sea breeze is hot and dry Temperature rises in going upward through the sea breeze into the surmounting air and sharp contrast is noticed in the humidity content of the two air masses When con- vection over coastal area stirs the sea breeze air into the lower part of the main current above, an inversion of temperature is likely to be found at quite a high level with moist air below The elevated inversion may then be carried over the sea by the upper wind, giving rise to an elevated radio duct over the sea

4 Horizontal Air Movement

When dry warm air from the land flows over the sea, it cools and becomes moist in the lower layers The result is the formation of temperature inversion and steep negative humidity gradient and these give pro- nounced super refraction This type of condition is encountered over long distances from the coast in the off shore wind in many parts of the globe during hot summer months

5 Fohn effect

A Fohn effect produces dry warm air on the lee side of a barrier which is high enough to produce conden sation on the windward slope If this air now passes over a sea or a damp land surface, temperature inver sion and negative humidity gradient develop in the lowest layers, leading to the formation of an efficient radio duct Fohn wind of this type is frequently en- countered in the sea areas around New Zealand Eas- terly winds flowing out over the West coast near Wel lington produces marked super-refraction as a result of the Fohn effect and looking westward from Welling- ton targets can be seen out to at least 150 miles by a 10 cm radar The unorthodox radar vision lasts only so long as the easterly wind persists and when the wind drops the target disappears *

*The writer is indebted to the Commanding Officer, Elementary Flying Training School, R I A F Jodhpur, for permission to publish this article to Dr B N Singh of Civil Aviation for giving some helpful suggestion and to Mr Sudhansu Deb, Secretary of the Radio Research Committee for revising the paper

CAN AGRICULTURE BE MECHANIZED ?*

Since the 18th century agriculture which has followed more or less closely the progress of mechanical arts, has been profoundly transformed and the advantages of mechanization of agricultural practices need no discussion today It must not however be believed that this mechanization might in the present state of our knowledge be extended to all agricultural practices and to every kind of cultivation and that the earth might be transformed into a mill to produce wheat cotton and beet just as flour mills sugar refineries or spinning mills produce flour, sugar or yarns The mechanization of agriculture requires discretion failing which it will provoke not only economical but also biological disasters because agriculture is above all a profession in which man has to struggle with the whole living world in all its forms vegetable animal and above all the microbes The mechanical equipments must be put at the service of life Its development which is today of vital economical importance still offers within the limits imposed by nature big scope to engineers Many of the troublesome operations are still performed by hand or with the help of rudimentary instruments at the cost of valuable time which the Agriculturists are ceaselessly trying to overcome by mechanization

IN the beginning, when the hunter or the shepherd adopted agriculture as a profession he at first obtained good results After several seasons of cultivation when the yield declined he selected new lands for exploitation This procedure brought disaster which later on spread even to the confines of nations and continents Only some few fortunate countries escaped this devastation particularly Egypt, thanks to the seasonal floods of the Nile, which reconstitute the arable layer by the deposition of sediment taken off from other places But how disastrous it is to deprive the earth of grass and trees (which are its hair, as it were) ignoring or violating the law of restitution! Babylon with its hanging gardens is a dead city in the midst of a desert Rome has thrown into its drains the wealth of Italian, Sardinian and Sicilian campaigns which are ruined since fifteenth centuries The Carthagenians, the Arabs and the Spaniards ravaging the forests of Spain and Numidia for lunching galleys have created Sierras and sand dunes The people of Southern France, after setting fire to the forest for the pasturing of sheep have created calcareus plateaus And the American experiment which has unfolded itself before our eyes illustrates this thesis strongly

THE PRIMITIVE CONCEPTION OF MECHANIZED AGRICULTURE IN AMERICA

The American experiment is linked directly to mechanization As in every colony it begins with the absence of methods the immigrants working according to the proved methods of their old countires But why give oneself so much trouble when there is an abundance of new regions? In course of *settlements* on land, nomadism appeared The soil was exploited as a mine when emptied it refused to produce and then one proceeded further to clear new grounds Since 1860 when the population increased, the settlers leaving moist regions settled in semi arid regions capable of improvement by *dry farming* Near about 1895 the vast clearings of the West characterised by the monoculture of cereals took place Though the average yield hardly exceeded 8 quintals* of wheat per hectare or $2\frac{1}{2}$ acres, crops were obtained every year only from half of the land, the other half lying fallow with drought, cattle were about to disappear and manual work progressively replaced by the development of instruments No more animals to feed and to be taken care of, no more manure For about 59 hectares,** a man, a tractor, some farming tools, a sowing machine, a combine, and a dragging wagon for carrying the grains to the pit were enough It was total mechanization!' The time taken to cultivate cereals on one hectare of land was 62 hours in 1850 as compared to $1\frac{1}{2}$ hours in these days, The cost was far less than that in ancient Europe Extraordinary progress which must bear its fruits, but this was not agriculture!

THE REVENGE OF NATURE

Within half a century the ill treated earth took revenge from 1907, many clearings gave signs of exhaustion In 1912, the farm of John Deere, holder of old patent rights of the pioneer Joseph Kemp, proposed to the farmers who were anxious in the reconstruction of the fertility of the soil, the use of the '*manure spreader*' But manure implies animals and the association of cattle breeding with cultivation This was realised much later Near 1920, the terrible phenomenon of *dust storm* appeared, the storm stripped off the sub stratum of its coat of tillable soil over thousands of square miles, the sky was darkened by it What happened? The intense trituration of the earth burnt the humus, a black, spongy, colloidal substance of organic origin, which could not be renewed for want of restitution The soil particles being disunited are exposed like fluid sand to atmospheric violence Nothing could check the storm over these denuded regions, and the condensations being irregular, the storms took the deluvian form, characteristic of sub desert regions The eolian and hydraulic erosions multiplied the ravages, denuding the rocks and covering with sand the streams of water and retrograding the sources thereof At the moment of accession of F D Roosevelt to the presidentship, it was estimated that the fertility of ¼ of the cultivable land has been irrecoverably destroyed In 1937, the soil conservation service was established Its function was to urge the locally interested persons to constitute specialised co operative societies and to give them technical help There are now in 1600 districts many co operative societies, having total membership of 32,50,000 farmers and ranchers out of a total of 6 million, The

* Translated from an article bearing the title 'Peut on Mécaniser L'Agriculture?' (See *Science et Vie*, May, 1947, p 212) by Mrs P N Bhaduri Ed *Sci & Cul*

*1 Quintal = 80 kg = 160 lbs = 2 maunds

**1 Hectare = 2 47 acres approximately

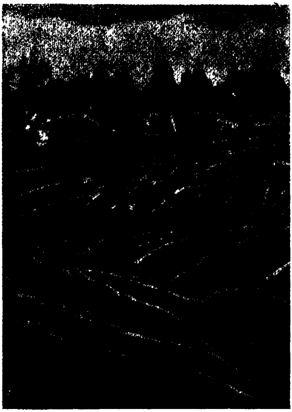
area concerned is 800 million acres These figures give the extent of disaster provoked by methods of cultivation, which was introduced by the demands of mechanization

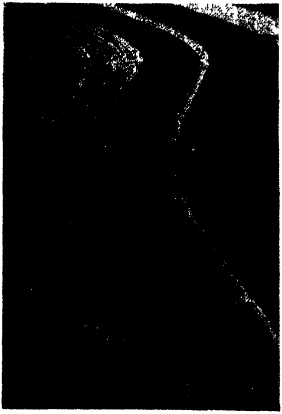
The soil conservation service recommended the following (*i*) planting of forest trees or fruit trees and bushes where nothing else grows, (*ii*) to cover with turf the banks of streams of water, construction of barrages for irrigation, (*iii*) creation and fencing of pastures and of earth work in terraces following the curve of the surface (Figs 1 & 2), (*iv*) stubble mulch

If Europe has discovered America the latter has discovered at last Agriculture—formerly disowned—which imposes laws that mechanization cannot change

Rational Agricultural Exploitation

It is not easy to give a clear and general definition of agricultural exploitation Gigantic or small, the farm is a living whole, as such it must be sustained in a permanent state of functional equilibrium maintained by vital phenomena of a cyclic nature to be expressed in a countable manner by balance sheets





Figs 1 & 2. The destruction caused by dry earth and its remedy the cultivation in terraces Fig 1 The ground, destroyed by erosion, shows the tragic result of careless cultivation neglecting the needs of the earth Fig 2 The large dark and bright bands correspond to the alternate cultivation of cereals and cotton in terraces following the bends and the level, in a cultivation at South Eastern United States

farming, (*v*) rotation of crops in cultivation and the rotation of cultivation, (*vi*) the breeding of (domestic) animals and restitution of organic manuring It is confirmed that during the past decade these methods have not only kept down erosion but the soil has been restored and as a result an increase in fertility of the production of food and fibres has taken place

We can now well perceive, in the midst of properly managed tree plantations, the harmonius existence of a mixture of meadows and cultivated fields, the alliance of cattle breeding and field-work and the rotation of crops directing the rotation of cultivations.

'Receipts—expenses," "entrance—issue," "feeding—consumption," "birth—death" It may be said that as everything comes from the earth, everything must go back to the earth! But actually it is not so, for there are exports and losses The art of an agriculturist, which tends to become science, is to reduce to minimum the exports and waste, and to compensate by imports those it cannot avoid Reduction of the export without endangering the financial equilibrium is another aspect of the question The fundamental mechanism is the transformation on the spot of the coarse products of low value to fine products of higher

value with recovery and reincorporation of waste to the earth It is better to sell milk, meat, wool, egg than grains, straw and fodder The natural cycle of fertility is to collect from the soil the vegetables consumed by the herbivorous animals whose products are sold, to recover their excrements and restitute this manure to the soil where the cycle closes by the work of microbes Thus the regenerated earth brings forth new food If there is a deficit the compensation will be met either by oil cakes and other concentrated foods incorporated in the food of the animals or by commercial manures complementary to the dung manure With the same object in view we must practise cultivation of the leguminous plants, which introduce in the cycle new elements mobilized in the substratum by their powerful roots and the work being accomplished by nitrogen fixing bacteria in their nodules The same cultivation, transforming the organic matter into nutritious soluble salts of the earth, will prevent every loss by infiltration frequent in bare soil Lastly the restitution of the pulp and offal in the cultivation of sugar beet, though exacting, furnishes, provided the pulp and residues are restored to the soil, an exportable product without taking anything from the earth For sugar is a substance wholly composed of carbon taken from air, and of hydrogen and oxygen taken from water

But these cultivations, no more than others, cannot be indefinitely repeated without causing a fatigue due to the toxins secreted by their roots, and which finally causes the earth refuse to produce Thus the agriculturists are obliged to organize agriculture by means of rotation of crops, root-crops alternating the stem crops and those crops which exhaust soil alternate with the leguminous crops which enrich the soil Against all these experiences it is clear that mono culture which is so much consistent with the industrial specialization "to do a single thing and make it better and economical" is only a primitive method The forest knows also the laws of protecting the earth, of restitution and alternation of the species! The orchard and vineyard, the usual forms of monoculture, end in the refusal of the earth inspite of addition of manures more by saturation by toxins than by exhaustion The decline of the Aegean plums could not have any other reason

Thus the true agricultural exploitation is a complex indissociable whole in which is combined poly culture and breeding In the simplest schematic form, it consists of five parts General working of the earth, sowing included, polyculture of rotatory vegetables, for sale, including harvesting and processing, protection of vegetables against parasites, rearing of animals giving exportable products, treatment with manure and fertilization of the soil

The productivity of the plantation has thus been carried to a maximum and it appears to persist indefinitely Cultivable lands in Europe well filled with animals and exploited for more than a thousand years, has generally increased till the discovery of mineral manures Since then, only where these manures have been rationally utilized, we have seen a progress without fail But the old practices complicate the problem of mechanization especially in the exploitation of a limited area and tend to diversify the work considerably

American Dynamism

Of the mechanical success obtained in the monoculture of cereals, something has remained The Americans had taken notice of the possibilities of the machine and its technical, economical and social advantages Determined not to do by hand any thing which can be done equally well, more rapidly and at less expense by mechanical processes, they have since then taken the right path It consists not in adapting agriculture to the mechanical possibilities but to adapt machines to the laws of agriculture, and this without affecting seriously the structure of the holding which is not so vast as is usually believed As against 60,000 big industrial exploiting concerns, there are 3 millions of family farms and 3½ millions of small non commercial farms, the average area being 70 hectares, 32 per cent of which is under cultivation The question that arises in America in the case of cultivation or breeding of animals is "Is it mechanisable or not, and if so to what degree, taking of course into account the present state of the species ?" If the answer is in the negative then the next question which follows is "May we not change the species by any process so as to allow mechanization?" For the industrial beet, whose slowness was marked, the slogan had been "The beet will be mechanized, or it would disappear " The mechanization of beet, though not yet a complete success, is however already far advanced

The European agriculturist being better provided with manual labour survived longer, and though they did not share this American opinion earlier have been later on compelled to accept it by force of necessity They have chalked out many mechanical solutions, often ingenious, sometimes widely adopted and retaken by the U S A , wherefrom they have reappeared with new splendour Nevertheless American agriculture due to the merit of monoculture, its industrial strength and its dynamism, has carried farthest the mechanization in all sections We shall now examine successively the general solutions applicable to agricultural methods as a whole and then to individual solutions pertaining to the principal cultivations and rearings

The General Works on Lands

The preparation of the land, indispensable to every cultivation, has as its aim, by mellowing and crumbling the ground, to aerate and activate the life of the nitrifying bacteria, to keep the soil open for water and to hold it firmly with the help of its spongy structure, to increase the absorbing power of the soil to manures, to destroy the weeds and prepare places for the seeds ensuring their deep rooting To attain these ends, the whole mass of the superficial layer of soil is worked up by passing successively various

instruments The method being old, it readily passed to motorization Without altering their principles, they had constructed for the tractor, ploughs with share, cultivation harrows, cross kills, rollers to which have been added sub soil machines, trench drainers, ploughs, pulverizers with discs etc The tendency has been to carry suitable equipments fixed on the chassis, which makes the tractor "all purpose", a precision self propelling machine amenable to various uses In the attempt to collect part or all of the opera tions in a single passage the advantage of the driving power of the tractor is minimized and the results ob tained become less perfect So the instantaneous mechanical preparations were sought for It has been achieved on the one hand by the *roto tiller*, the American version of "Phrase Rotatif" invented by M de Meyenbourg and well known in Europe and on the other hand by the various American machines provided with an endless screw rotating with great speed, this is fixed on the plough to play upon the deep furrows laid open by the "Mould-board" The earth thus treated by force is better dug than those ploughed by natural means, they take in clots Another British conception is *gyrotiller*, plough provided at the rear by horizontal rotary discs armed with pick axes, triturating the ground up to depth of 1 metre (Fig 3)

Fig 3 'Gyrotillage' *of ground* The 'gyrotiller' is a tractor with a plough provided at the back of the horizontal discs armed with pick axes which triturate the ground to a depth of 1 meter (Fowler)

In the United States the reaction against labour is quite clear and the fight against the earth is the cause The practice is *Stubble-mulch farming* or sub surface farming This method recalls that of Jean de Bru, used in France in sub mediterranean climates under identical conditions Whatever the procedures and the instruments, a single man with the help of a tractor do all the agricultural works

The tractor being provided with a digger can also dig holes, corresponding to preparing the ground for planting trees The same result is obtained, not more mechanically, by agricultural explosives which became common in France through Colonel Piedallus It has got definite advantages, because it furrows the ground arround the hole facilitating uprooting The explosive also helps in the reconstitution of the eroded soil as has been demonstrated in the regions of Algiers

Sowing

Seeds are sown by spreading or in parallel rows by means of mechanical drills ensuring regular and constant distribution Sowing in rows is more precise as seeds are thrown into the furrows which are dug to the required depth and covered with earth, the work being done by a single operation, the more regular raising of the plants brings on an economy of seeds, the subsequent reaping also becomes easy from a distance of 30 cm between the lines The process would be perfect if the seed beds are sown with seeds, equidistant and in rows A drill made in U S S R would attain it by a curious method a drum of sheet iron, perforated with holes having diameter smaller than that of the seeds, turns in the hopper, a depression of air is maintained in it so that a single seed is stuck at each hole functioning like a valve, at a certain point an obstacle exerting a pressure from the interior detaches the seed and lets it fall, thus mechanically, the seeds are placed one by one equidistantly, a work which is impracticable by hand

But, for big areas, the sowing from the air can resume its importance if it is done by aeroplane or autogyro If the lighter seeds are required to be placed inside the ground at a certain depth, it is necessary to ballast them by putting a covering, so that they may strike the ground with a speed and a weight assuring their penetration 7000 hectares have been thus sown re cently in U S S R by aeroplanes flying at an altitude of 20 to 30 meter and with a speed of 100 km per hour

Fight against Parasites

The cultivated plants, to give a capital yield should be freed from weeds and protected from the attack of parasites, insects and cryptograms The technique of combating the attack is applicable to different types of cultivations, it is mechanised by using weeding hoes (binots), pulverizers and powder spreading machines For weeding, weeding hoes are only used in the beds where seeds are sown quite apart from one another, such as maize, beet, potato If a precise work is required it is necessary that the hoe or light plough should correspond exactly to the drill utilized This condition is perfectly realized with the *all purpose tractors* by means of a bar carrying implements fixed in front of the chassis, within the sight of the driver Upon that bar, drills or weeding knives are placed The most ingenious thing is that each drill is kept on working by two cylindrical interchangeable hoppers When one is empty, the other kept full in reserve replaces it at a stroke

But henceforth equal distribution is adopted by means of pulverigators or powder-spreaders. This method

adopted by the Frenchman Rabate, consists of spraying mechanically a solution of 6 to 12 per cent of sulphuric acid at 35° Baume at the rate of 1200 litres per hectare It is applied to young cereals in spring and destroys the charlocks, wall flowers, corn poppies, etc The selective action depends on the form of the leaves and the texture of their epidermis those of the cereals being narrow and smooth hold only a little quantity of the solution whereas the weeds having large and hairy leaves retain it and thus they are burnt The use of the ground sylvinite for weeding which is based on the same principle, has given rise to dustings The artifical hormones, recently put to the point in England, if their success is confirmed, will bring a definite solution the dusting is done by means of a simple instrument, a little quantity of hormone being mixed with 400 kg of ground chalk for one hectare, the selective action is achieved by internal mechanism, all the plants absorb through their roots the hormones which though indifferent to the monocotyledons put to disorder the vital functions of the dicotyledons

To destroy the insects and cryptograms, it is always chemicals which intervene in the form of solutions and powders, the mechanization is realized by pulverigators or powder spreaders under pressure or air current The apparatus are fitted with motors, tractors or they are carried For the fruit trees stationary machines are used provided with pipes and nozzles The dusting as against the insecticides and fungicides is more specific and less injurious, it economises the transport of considerable quantity of water, its effectiveness appears to be due principally to the electrification of the powders, which are thrown upon the plants and put electrically on the ground by their roots

In England a special autogyro provided with a powerful pulverigator, the *Spraying Mantis*, has just been experimented It treats about 200 hectares per day Nothing seems to oppose dustings and sprayings executed in the same way Thus the problem of protection of the cultivations against all their enemies, plants, cryptograms and insects, which cannot be solved only by generalized and simultaneous treatments, needs a collective solution

Mechanization of Cultivation

We shall confine ourselves to the essential methods with reference to fodders, natural and artificial, corns, flax, beet roots and potatoes only

The Fodder For the fodders the mechanization is wholesale Their preservation is made by fanning or natural or artificial dessication, stacking and binding Except in the first case, still quite common, the time factor is partially or totally eliminated The 'tractor reaper' or the 'machanized cutting bar,' the rotating or *forked fan* and the *'ratofane'* first collects, then the mass loader intervenes and lastly the 'unloader' or the *pneumatic lifter* discharges the dry hay on the hayloft In place of the loader the British and American practice is to use the *pick-up baling*, of which the recent belted models, without piston, roll the reapings into bales In Switzerland some concerns dry the green hay in electric dryers The sun drying method permits, by converting the hay to three fourth dryness to obtain in the granary a brown hay very much liked by the animals For the collection of the grains, the green fodder is brought to the grain collector which chops it and blows it out pneumatically The difficult loading of maize is eliminated by the Americans by means of a machine carried in front of the tractor, which cuts, chops and pours the reapings in a motor driven container running parallel with it

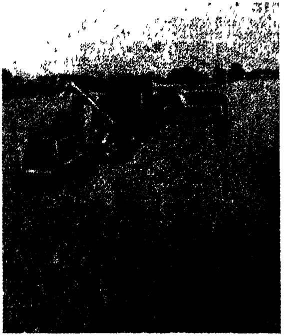


Fig 4 The combine or 'Harvester Beater' Worked by a single man, this machine cuts the tips, beats and collects the straw in bales in the field and the grains are poured in the attached carrier (U S A)

The Corns We know that the mechanization of cultivation of corns was first applied to grain distribution The 'combine' or harvest beater, is the instrument for reaping (Fig 4) The straw is cut at regular levels, beaten at the end together with the husk and then poured in bulk in the field, after which the grains are separated, washed, dried up and poured in an attached carrier The straw, formerly used to be burnt up, is now collected for the cattle This is done by the process of *pick up baling* A rainy season modifies this technique the corn is then cut by a mowing machine to such a height that it rests on a brush of straw isolating the ears (of corn) from the ground The rough variety of straw is to be separated Then, when the sun's heat is again available, the 'combine' from which the cutting bar has been replaced by the pick up collects the thatch harvest and beats it The 'combine' has gradually given rise to the type called *all crops* which cuts not exceeding 2 meters.

It has been adopted in family farms, which is treating the roots, peas, haricots, lentils, beans, oil seeds as well But for the better exploitations, recourse is taken of the self propelled types with frontal cutting strokes, which can go very close to the hedge, thus avoiding a considerable loss In France the machine permits the straw to be bound up in bundle, making all the operations in a single passage In England they made an attempt to bring to the small holders the advantages of the 'combine' at the price of a reap ing machine through the introduction of the 'corn picker' (Fig 5) The principle here is to beat the corn at the foot, without cutting it As for the maize, the special reaping machine placed before the tractor collects its ears, disengages them from the leaves and pours them by transporters in a case (Fig 6) The taking out of the grains mechanically is effected only after drying

Fig 5 The reaping of cereals by 'Corn picker' in four rows The five clutches of this machine pass between the rows of corns, separate the grains with out cutting the plants and collects the grains in the carrier fixed at the back Such a machine can reap more than 10 hectares of wheat per day

Flax In the harvesting of the flax the up-rooters fitted with a large number of belts are used The stems pinched between the two tangent fly wheels tied to the belts are led to the binding machine During the course of this movement, the roots are broken by traction The tied up bundles are laid on the ground, the fibres preserving their total length A machine with identical principles is used to uproot the haricots, it differs from the above only in the absence of the finder in the binding machine

The beet-roots. The mechanization of this crop, although much advanced is not fully achieved It is not certain whether it will ever reach a stage of perfection The full production is only obtained from

Fig 6 Machine for reaping maize This tractor moves between two rows of maize the corns are auto matically pulled cut, removed of leaves and poured in a cart which is replaced immediately as soon as fillo l up (U S A)

isolated and equidistant plants, the cultivation not entailing gaps Now the beet root seeds have the peculiarity of being mono or poly germinal in variable proportions Therefore seeds sown even equidistant to each other do not solve the problem because it can give rise to one, two, three or even four plants at a time The mechanical and scattering transplantation gives a sure result only in certain rainy climates The preparation for the growth of plants is a big task, and can only be done manually Three methods are used to remove this difficulty (*i*) selection of mono germinal seeds, which is a prolonged work of uncertain results, (*ii*) the segmentation of the seed as practised industrially in the U S A with relative success, (*iii*) the preparation of mono germinal seeds obtained by husking the grains and covering them in an artificial gauge But the single grain or mono germinal seedling is faced with two obstacles the seeds grow better in groups than in isolation, the risk of losing is not excluded The separation again is effected by hand, which in extreme cases is eliminated through the employment of segmented grains

The American farmer sows nearly in continuous lines, places the plants at equal distance while weeding by hoe the tractor moving perpendicularly on the ground keeps them aloof from one another by cutting or pulling out the beet roots which are present in excess At this stage the digging machine of a Frenchman Mr Ferte promises considerable service This machine is characterised by the possession of a 'sense' as it were It was in the first version of it achieved by a photocell, but Mr Ferte substituted a "brine tester" in its place It is realised by a metallic "finger', mois tened by an electrolyte and kept in tension The circuit is closed when the finger enters into contact with the leaves of a beet root, and it results in the instantaneous lifting of the blades which saves the plant,

The machine is regulated by automatic 'adjusters', the 'brine tester' in case of need starts the lifting at the contact of the first beet root encountered Thereafter, the mechanism repeats

The mechanical uprooters are quite useful, but one experiences difficulties in many French soils, generally the heavier ones In U S A use is made particularly of the 'up rooters' working in one or sometimes two rows The roots removed by the plough shares are held by pincers and are trimmed, to prevent sprouting, by means of a rotating disc and they fall in the elevator-transporter which cleans them and pours them in the carrier of the truck running by the side of the up-rooter In France, although the first experiment of Mr Moreau made in 1912 is now backdated, it was never so popular The up rooters, operating 1, 2, 3 and even 6 rows, are well distributed The principles involved are identical, but the trimming accompanied by the separation of the 'greens' is still effected before the up-rooting by oblique or a rotating knife, operating at the desired height by a 'feeler' sliding or rolling on the top of the roots These are grouped in rows mechanically and a pick up loader collects them and fills in the container attached to the vehicle

The Potatoes As for potatoes which reproduce by tubers, the first machine is the 'planter' which distributes them on the ground at constant depths one by one, at regular intervals Numerous inventors have tried to solve the problem The semi automatic planters are perfect, but they require, on the seat for each row, a man who places one tuber in each socket of the distributor The two difficulties to realise complete automatisation here are double tubers in the same socket and the empty sockets The mechanical separation of the plants with the help of the 'Callibrated-Assorter' helps very much in the working of some of the automatic planters which are perfect in this respect The digging and earthing up are made by means of hoe The 'up rooters' are to the point, their share lifts up the earth containing the tubers, the latter are extracted by sifting, by means of rotating blades or rolling transporters (Fig 7) Some machines dry them up and realise all the operations at a single passage But except the light and dry earths, it is preferable to leave the tubers in lines exposed to air As with the beet roots, the work in heavy soils increases the difficulties

THE MECHANISATION OF REARING OF CATTLE

All types of rearing call for general problems of feeding, lodging and hygiene, to which are added the milking of milch cows and the furring of lambs

The summer feeding is principally done by grazing In fencing of the passages, meadows, fields, etc, the supports are rapidly planted with the help of a digger The electric fencing brings in a simple and economical solution by reducing the number of metallic wires to one only A transformer fed by a battery gives at a high voltage a feeble current to the fencing wire, the animal coming in contact with the wire, closes the circuit through the ground and is badly shaken After some experience its instinct makes it avoid intelligently all the wires, even those not charged The winter feeding is done in the stable A logical disposition of the buildings containing the foodstock and

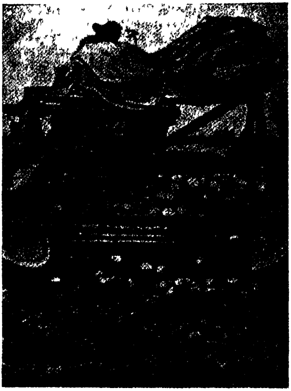


Fig 7 Reaping of potatoes A reaper which lifts up the earth containing the tubers and cleans them by sifting They are then collected and put in bags The machine lets these fall at regular intervals

the stables simplifies the work The wire fencing, without which the Americans do not think of rearing, is less employed in France Because of the advantages already obtained from previous mechanised operations the only operation which remains is the distribution of the food For the preparation of the rearing ground numerous motorized machines intervene, root cutters, beet up rooters, straw choppers, pulp mixers, cake breakers, grain crushers, mill, fodder-pressers, fodder-chopper, etc

The cooking of food for pigs which is indispensable is done by electric ovens Where there is no public distribution, the use of motor pumps ensures individual automatic water supply, increasing the output and considerable economy of time Water under pressure, in buildings provided with drains and proper flooring, permits daily washing and maintenance of excellent hygiene

The electro pneumatic milking machine with intermittent strokes eliminates a manual work which generally annoys the workers The results are perfect specially with the types with long and soft nipples,

The milk, drawn in absence of air and soiling agents, is clean and healthy, provided the organs are disinfected after each operation by slightly chlorinated water The saving of time is appreciable because of the possibility of milking simultaneously 3 to 4 animals at a time The machine is used even in small farms with 5 to 6 cows They are made in definite models suited to stables and the rolling permits operation on ground The animals are easily habituated to the method of milking In U S A, in extreme cases, the rotolactor is available This is a cellular rotating plate, equipped with milking machines with disinfecting arrangements and warm douches for the animals It can tackle 250 cows per hour

The mechanization of furring of lambs, first introduced in Australia, is done by motorised units Now this has spread more or less throughout the whole world The specialist has to intervene here also, as it used to be before mechanisation, but now this is done with much speed and the fleece is very much improved and properly graded

The Treatment of Fertilizers and Fertility of the Soil

The indispensable restitution, compensating loss and exportation, applies to all soils and for all cultivations It is done in three forms (*i*) from vegetables, the short-cut method, (*ii*) from animals, by confining them in stables, or (*iii*) by the use of artificial fertilisers, organic or mineral

The restitution in the 'short cut method' does not show apparent benefit It is effected by the 'Green manures' When a piece of land lies fallow for more or less a long period, a crop is sown, preferably a leguminous one Before the pods are formed they are put under the plough after being embedded in the ground by a roller The losses by infiltration are avoided, a gain of nitrogen is obtained, the distribution of the nutritive principles of the soil are not modified but present itself in an assimilable organic form generating humus

When the animals graze on this fodder, they gain either flesh or milk The restitution of the soil is achieved further by a short cut through the animals It is effected by the excretions which are not removed If the animals are placed in stables, they also gain flesh or milk, the product of the farmer, and the circuit is prolonged This production is indispensable, because in contrast to the preceding system, it permits the removal of the elements from the soil and allows accumulation where they become more useful If the number of animals is insufficient recourse is taken to 'artificial fertilizer', by watering and fermentation of straws for each ton of straw, there must be 2500 litres of water and 5 kgm of nitrogen and 25 kgm of ammonium sulphate, Mechanization will rapidly intervene here! There already exists a "preparator of artificial fertiliser", which disintegrates the bales, waters the straws, fixes nitrogen by its passage through a nitrogeneous solution, after 80 days of fermentation a homogeneous substance is obtained apparently identical with natural fertiliser It now remains to be known whether in course of time new substitutes will be discovered

For the natural fertilisers, the collection and treatment are facilitated and improved by cleansing the stable grounds, establishing gravitational drains, constructing rationally the fertiliser godown and its drainage, using single rail transport driven by motor and the use of motor pumps frequently watering the putrified mass The loader is used in America for loading the vehicles This implement is adopted for the all-purpose tractor two lever arms making a bridge from behind serve to form the hood, they are overlapped in front and terminate into a balancing hamper provided with sharp projections, a hydro electric or mechanical driving wheel puts the lever in high or low position, the hamper shaves the ground and the conductor driving forward penetrates into the heap bifurcating it Then bringing the lever in high position and the conductor driving backward for a quarter turn on the place and bringing the blades just above the hold of the vehicle causes displacement This vehicle is a *mechanised manure spreader*, which on advancing brings the charge of the manure on the spreading cylinder

The introduction of organic or mineral matters, whether compensatory or beneficial, are achieved by the cakes and the fodder which are again obtained partly from the manure For the soil fertilised with putrified vegetable manure, the mechanisation should be supplemented by the use of *loader* and *manure* spreader For commercial manure, the complementary role of which is imperative and precious for correcting the deficiencies of soil and to increase the efficiency of the fertilisers, the probems of mechanization were solved long ago by breakers, mixers, and the spreaders With the help of tractors, the work can be speeded up by attaching to the spreaders interchangeable systems which carries the reserved manure in bags or in tins on a platform, permitting reloading, when in motion

Unsolved Problems

Mechanisation in agriculture has thus been advanced very far Either for technical difficulty, or for biological reasons not an inconsiderable number of problems have still remained unsolved The separation of the beet roots is an example to the point The machine, although selective can operate only in simple homogeneous soil Although the Americans had experimented in Oregon with *filbert hervestor*, a giant aspirator which collects the nuts, in California they are still plucking their apples by hand It is odd looking to see a machine entering an orchard for making operations such as plucking, selecting fruits amidst foliage or gathering grapes! The idea of quality of the products first, which is gathering more importance, and the principal biological necessities for the continuation of the cultivation, oppose each other However advantageous the machine may be, it loses its merit at the moment it enters into competition with biological necessities

THE SCIENTIFIC ACTIVITIES OF ACHARYA JAGADISH CHANDRA BOSE*

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MR President, members of the Indian Radiological Congress, ladies and gentlemen I have first to express my deep gratitude for the honour you have conferred on me by asking me to give an introductory talk on the life and scientific activities of my uncle, Acharya Jagadish Chandra Bose, as an introduction to the delivery of a Memorial Lecture by Dr Barclay of the Nuffield Medical Research Institute, Oxford From my boyhood days I have been an interested observer and at times a participant of his many sided scientific activities, from his pioneer short electric wave investigations commencing from 1894 to his later well known plant physiological researches Since his demise on 23rd November, 1937, the responsibility of directing the Institute has devolved on me, which has given me the opportunity of making a close study of his scientific researches I hope soon to publish a monograph on the relation of his plant physiological researches to modern biological knowledge

The distinction of having a Memorial Lecture founded in his name by your society, rests on some more concrete grounds than in your desire to honour the memory of a distinguished Indian pioneer in physical and biological researches, famed for his rare experimental skill and capacity for construction of compact sensitive instruments and automatic recorders He was essentially a biologist in his outlook, who even interpreted his physical discoveries in terms of biological concepts and intuitively followed the line of investigation which formed a bridge between responses in non living and living systems

He was, I believe, the first person in India to reproduce Roentgen's discovery in 1895, of the generation of X-rays in a cathode ray tube Reading a newspaper account of Roentgen's discovery, Bose, then Professor of Physics in Presidency College, Calcutta, set a young research assistant Nagendra Chandra Nag, who later became the Assistant Director of the Bose Institute to prepare Barium Platinocyanide screens with which he took X ray photographs of different objects, like a human hand, coins enclosed in a purse etc, some of them were reproduced in a juvenile monthly '*Mukul*' for which he used often to write popular articles on scientific topics in Bengali Later on, when he became immersed in his plant physiological investigations and discovered the similarity of reactions produced by different alkaloids and anaesthetics on animal and plant organs, the opposite effects of minute and ordinary doses of such drugs on plant tissues, he was invited to give an address on this subject before the Royal Society of Medicine Sir Lauder Brunton, the well known physician and contemporary of Charles Darwin, after attending this lecture wrote to J C Bose, "All the experiments I have yet seen are crude in comparison with yours, in which you show what a marvellous resemblance there is between reactions of plants and animals Much light would be thrown on the action of drugs on animals by using your method " Bose also delivered similar addresses before the Hahnemann Society of England My uncle at one time had investigations carried out in his institute on the possibility of producing antibodies in plants inoculated with virulent bacteria like typhoid etc This investigation was not however successful

After giving a short account of his early life and education at home and abroad, of his activities as Professor of Physics, Presidency College, Calcutta and of the events following his retirement from Government service which led to the foundation of the Bose Research Institute, the lecturer proceeded to describe J C Bose's scientific activities

SCIENTIFIC ACTIVITIES

Turning to J C Bose's scientific activities, we find that for the first ten years he was chiefly engaged in his teaching work and in the pursuit of scientific hobbies At one time he used to go out during the holidays accompanied by Lady Bose and armed with a full sized plate camera, to places of archæological interests or of some natural beauty Probably the reading of Cunningham's and Rajendralal Mitra's books had aroused his interest in the archæological remnants of the former greatness of his country He also was probably the first in this country to import in 1892 one of the early models of Edison's phonograph, with which he used to record the voices of well known singers and distinguished personalities I have mentioned before his interest in Roentgen's discovery of the X rays It is not known what induced him to give up his scientific hobbies and to take up serious research Probably Lady Bose influenced him in this direction In one of his lectures he mentions that on the 36th anniversary of his birthday in 1894 he took the resolve to seriously take up scientific research Considering the primitive equipment for instrument making and absence of atmosphere conducive to research then prevailing in the Presidency College, Calcutta, his decision must be considered very remarkable His research activities, extending from 1894 to 1937, can

*From an address delivered before the Indian Radiological Congress on 25th December 1948 and reprinted from the *Indian Journal of Radiology*

be divided into three periods. In each of these periods his efforts were directed towards the solution of problems lying in the border land regions of sciences During the first period from 1894-1899 he was trying to produce the shortest of the then possible wavelengths of electromagnetic radiation, and to measure their quasi optical properties by means of an ordinary optical bench arrangement

The second period, extending from 1899 1904, began with his study of the fatigue effect in metallic coherers used for detection of electric waves, from which he went over to the study of other inorganic systems which exhibit, under different kinds of physical stimulation, responses analogous to those exhibited by living organisms This led to his famous generalisation on the similarity of responses in the living and the non living The third period starting from about 1905 was concerned with plant physiological investigations, where he tried to establish the similarity, if not the identity of response to stimulation exhibited by animal and plant tissues

First period

It will be remembered that in 1865 Clerk Maxwell formulated his epoch making theory, that light waves are of electromagnetic nature propagated through space with a velocity 'c', which is equal to the ratio of the two systems of units in which electric resp magnetic quantities are expressed This theory found experimental verification in 1887, by Hertz's production of electromagnetic waves of wave length 5 5 meters, whose optical properties he was able to determine by means of very large sized parabolic reflectors and prisms For the detection of such waves Hertz had used a loop of copper wire, with a minute spark gap Branly had shown later that these waves could also be detected by measuring the change of conductivity which a tube containing metal filings suffered by absorption of such waves Bose by reducing the dimensions of his wave generator system, was able to produce radiation of wave length of the order of 5 mm, which is about 1/10,000 that of Hertz's wave For purpose of comparison I will state that the wave lengths of visible light, of soft X rays, and of hard γ-rays are of the order of 10^{-5}, 10^{-7} and 10^{-10} cm respectively

By reducing the wave length of his radiation Bose could considerably reduce the dimensions of his optical appliances He could focus his radiation by means of a small spherical reflector, polarize it by means of wire grating, study its indices of refraction in air, water, glass, pitch, sulphur, show how its plane of polarisation could be rotated by passing it through a a bundle of twisted jute fibres and so on Bose's compact portable apparatus for the study of the properties of electro magnetic waves was very much admired, when he demonstrated it at different centers of research in England and in western Europe Many text books and monographs described in detail his apparatus, including J J Thomson's well known book on 'Electricity and Magnetism', his article in the 9th edition of the Encyclopaedia Britannica and Poincare's book on electric waves Investigations on the centimeter wave length region of e m waves remained in comparative oblivion for the last fifty years, and they have come again into importance during the last war, when the technique of production and detection of such waves were developed to an extraordinary degree, in connection with the radar method of detection and interception of enemy air planes The use of the shortest possible e m waves in which the maximum output of energy could be concentrated became of supreme importance for this purpose, first it enabled the construction of portable reflecting systems concentrating the radio beam to follow the track of the enemy air planes, and secondly the short wave length used enabled the incident waves to be reflected to an appreciable extent from the surface of the enemy planes Profs M N Saha and S K Mitra after return from their tour in the U S A in 1945, informed me that in many university laboratories where radar personnel were being trained, apparatus similar to that developed by J C Bose were used for practical instruction The measurement of the absorption of these centimeter waves by the constituents of the atmosphere like O_2, N_2, CO, water vapour and other substances became of great importance These recent measurements have verified some of those made by Bose with similar substances The important advances in the present day technique has been in the generation of extremely powerful pulses of centimeter waves of nearly monochromatic frequency, while Bose's generator emitted only feeble damped waves, otherwise the principles employed have not altered very much Bose had employed amongst other detectors crystals like galena At the present time it has been found necessary for the detection of such extremely short waves again to use in the first stage of the detecting unit, crystal detectors of different kinds, of which the most useful are those of silicon and germanium A new line of investigation on the absorption and emission of such microwaves by nuclei, atoms, molecules and crystals have been opened out by peaceful application of microwaves, and already several results of first rate theoretical importance have been obtained

Second period—Response in the living and the non living

This was initiated during Bose's investigations with the coherer which in the form devised by Branly consisted of metal filings, which under the absorption of electric radiation cohered together and thus increased in conductivity Bose investigated a large number of metallic and semi metallic substances and found that coherer action arose at the places of contact between different pieces of metal filings forming the coherer, i e, it was a skin effect for which he coined the name 'electric touch' using the last word as equi-

valent to the sanskrit word *'twach'*—skin He found that with constant use the coherers showed signs of fatigue and given some rest they recovered from fatigue He simplified the design of coherers and in the latest form of apparatus which we still use in the Institute, the receiver takes the form of a single contact between a fine metallic point resting on a metal plate, the materials used for the purpose are steel, nickel magnesium, and other metals

Having studied the metallic coherer whose conductivity increases on absorption of e m radiation, Bose continued his investigation with other detectors of radiation like the crystal galena whose contact resistance diminishes with absorption of radiation, ranging from micro electric waves to ultra violet light, with semi conductors like selenium which change their resistance during light absorption, and photoelectric cells made of silverplates activated by exposure to Bromine vapour etc

At present this class of semi conductors including crystals like galena, metalloids like silicon, germanium, selenium, copper oxide films deposited on metal bases, are used for rectification of alternating current of frequencies ranging from say 50 per sec , to that of micro waves and of visible light, some of these substances have important application in the recent attempts at industrial conversion of solar energy to electrical power Another recent development of Bose's discoveries is based on his last form of coherer, consisting of a sharp metallic point resting on a crystalline metal surface , this has the additional property of rectifying e m radiation impinging on it and thus has a function similar to that of a diode valve like Kenotron so familiar to Radiologists Recently an adaptation of it has been reported from the Bell Telephone Co It starts as an arrangement of a fine wire electrode resting on a surface of a germanium plate, and used for rectification and detection of high frequency e m radiations , if now an additional wire electrode is made to touch the upper part of the germanium plate very near the first one, and a constant voltage is maintained between the plate and the second electrode, then it becomes equivalent to a triode valve, in which the first wire plays the role of a grid electrode The arrangement can be used to detect and amplify feeble a c currents, as well as to generate high frequency oscillations This simple arrangement, denoted Transistor, promises to replace the glass triode valves in many circuits I have given this account of the recent developments in the technical application of semiconductors to show how they were implicit in Bose's investigations of half a century ago

The results of these investigations on the change of conductivity of contact resistances, the e m f generation by absorption of short electric waves and of light, were considered by Bose as part of the general phenomena of response of inorganic substances to stimulation Starting with Waller's dictum that in living tissues, the most delicate and universal sign of livingness is electric response to stimulation, Bose enquires whether inorganic models may not also be devised which will satisfy this criterion In this way he was able to construct models in which mechanical and light stimuli produce electrical responses The proportionality which exists between intensity of stimulation and electrical response, the gradual appearance of fatigue in response after repeated stimulations, from which the system recovers after it is given sufficient rest, the increase of response on treatment with one set of chemicals and its inhibition by another set, are similar to what occur in living tissues I shall describe here only one of his models, it is made of two wires of pure tin, whose lower ends are clamped to an ebonite block , the upper ends pass through an ebonite disc, and are joined through binding screws to the two terminals of a sensitive galvanometer The arrangement fits into a cylindrical glass vessel, filled with distilled or tap water On giving one of the tin wires a sharp twist, an electric current flows from the wire through the galvanometer system The amplitude of response is enhanced when a small quantity of sodium bicarbonate is added to the distilled water , on the other hand if oxalic acid is added to the water the response is totally abolished Many of the effects observed in animal tissues under stimulation *viz* , the opposite effects of small and large doses of a chemical poison etc can be obtained with this model of Bose In a lecture delivered before the Royal Institution, London in 1901, Bose after showing a series of parallel experiments on the similarity in response shown in living and non living systems, ends his lecture with the remarks "Amongst such phenomena how can we draw a line of demarcation and say 'here the physical process ends and there the physiological begins ? "No such barrier exists Do not the two sets of records tell us of some property of matter common and persistent Do not they show that the responsive processes seen in life have been foreshadowed in non life, that is the physiological is after all an expression of the physicochemical and that there is no abrupt break but a continuity?"

Later investigations on plant responses, where he tried to show the similarity if not identity of responses shown by plant and animal tissues under stimulation, Bose had to make some distinction between physiological and purely physicochemical response shown by living tissues

Bose himself was not quite clear as to the real seat of the electromotive response produced in the tin wire system under mechanical stimulation—at one time he thought it to be at the surface of separation between the tin wire and the electrolyte—this can explain the difference in the e m f produced under constant stimulation, when the distilled water in which the wire dips is replaced by dilute solutions containing $NaHCO_3$ resp oxalic acid Later he thought it was due to molecular strain induced in the twisted wire itself. I shall describe two other inorganic models illustrating response of living systems, in which it is clearly established that a passive layer formed on the surface of a metal dipped in an electrolyte is responsible for such response effects The first is the famous iron wire

model of Lillie (1920 1936) which has its starting point in an observation of Ostwald in 1900 Wires made from specially pure iron, when dipped in strong nitric acid (sp g 1 4) enters into a passive state shown by its surface taking a bright metallic lustre If however, it is touched by an active iron or by a zinc rod, a local action accompanied by effervescence and a darkening of the metallic lustre spreads rapidly over the wire from end to end, the local action ceases after one or two seconds and the metal reverts automatically to the passive state An electric disturbance accompanies this process and can be recorded by a string galvanometer With such a system Lillie demonstrated a correspondence in the most unexpected details between the excitation of nerve and the activation of passive iron Bonhoeffer, the well known physical chemist who has been during recent years making an analysis of the activation phenomena, remarks 'it is indeed most astonishing that iron wire and nerve, which from the chemical point of view differ so enormously, function in such a similar way It does not seem credible that the various functional properties in which the two systems resemble each other could be independent or show such accidental similarities The existence of a threshold of activation, of a refractory period, of a transmission of activation, of a tendency to give rythmic reactions and a suggestion that the so called accomodation effect are not missing in the model, indicate that all these properties, so uncommon in ordinary chemistry, are in some way related to each other "

The other model which I shall refer to is that of Bredig (1903), illustrating the rythmic pulsation of an animal heart It is based upon the decomposition of hydrogen peroxide when spread over the surface of a mercury drop When the peroxide solution is slightly acidic a stable golden brown film is formed on the mercury surface this corresponds to the inactivation of the tin wire in Bose's model by dilute oxalic acid At an appropriate degree of alkalinity, the film is stimulated to activity shown by its alternate breakdown and reformation with the evolution of oxygen, this is accompained by rythmic alteration of the shape of the mercury drop, due to variation in its surface tension and of a propagated electric disturbance on the surface This state corresponds in Bose's model to making of the aquous solution in which the tin wire dips slightly alkaline by addition of sodium bicarbonate These reversible films formed on metal sufaces, correspond in the living system to the plasma membrane forming the outer boundary of living cells, on whose both sides are present electrolytes with different ionic concentrations The whole group of response phenomena shown by living systems, under chemical, electrical and mechanical stimulations, depend upon the change in conductivity and of ionic permeability of this plasma membrane, which is accbmpanied by an alteration of the resting bioelectric potential This local change in bioelectric potential is propagated along cell surfaces especially of nerves as excitation current

The similarity of response to stimulation exhibited in inorganic models is due to its make up of a conducting metallic core separated from a conducting electrolyte by a layer on the surface of the core in a passive state The latter breaks down reversibly under mechanical, chemical and electrical stimulations resulting in production of local currents between the intact and decomposed portion of the surface film Bose was not familiar with the contemporary physico chemical investigations carried out by men like Ostwald, Bredig and their schools, and was therefore unable to undertake a correct interpretation of these borderline investigations of his While his western contemporaries designated them as inorganic models of some properties of living systems, Bose with his pantheistic back ground saw in this similarity an evidence that the responsive processes seen in life have been foreshadowed in the non living'

Plant Physiological Investigations

From this study of the borderland region separating organic from inorganic response phenomena Bose was led to investigate plant responses, which again represent a border line region in the study of the highly organized and differentiated animal organisms Bose starts with the assumption that in plant as in animals the underlying protoplasmic matter has the same fundamental properties of irritability, contractility, conductivity and rythmicity In the highly organized animal organisms, some of these characteristics are specialized in one or other of the tissues *e g* contractility in the muscle system, conduction of irritation in the nerve system, and rythmicity in the heart muscles The tissues in the plant have never reached anything like the same degree of differentiation as in animals it is only in a general sense that it is possible to apply the terms 'muscle' and 'nerve' to the contractile and excitatory tissues of the plant

Bose in the course of his investigations selected three plants in which one or other of the three functions are specialized For, example, the lateral leaflet of the plant *Desmodium gyrans*, even when detached from the parent plant, and kept with its cut end dipped in tap water, continues to execute regular gyratory pulsations of periods varying between 2 to 4 minutes, depending on the age of the leaflet, temperature etc These leaflets, like animal hearts, are myogenic *i e* the part originating and regulating its pulsations lie in the leaflet and the latter is very little influenced by stimulation applied to the rest of the plants Application of cold, of chemicals, of stimulants and depressants, influenced its activity in a similar manner as when applied to the isolated animal heart The pulvinus and leaf system of the sensitive plant *Mimosa pudica* behaves under stimulation in a manner analogous to that of a nerve muscle unit Stimulations, thermal, mechanical or electrical in nature, applied to the stem is conducted, principally in the form of an excitation current, with welldefined velocity, which on reaching the pulvinus leaf system causes the collapse of the pulvinus and closure

of the leaf system Many of the characteristics of response to stimulation shown by innervated muscles, can be shown in a pulvinus leaf systems of mimosa plant, like summation effect, stimulation by constant current, repetitive responses to strong stimulation, the influence of direction of flow of a small constant current in enhancing or abolishing the mechanical response of the pulvinus to stimulation, the reversible depression of conduction of excitation by means of cold, by anaesthetics like chloroform and ether, and its abolition by poison

In another plant *Biophytum sensitivum*, the all or none response to stimulation and repetitive response to strong stimulation characteristics of skeletal muscles are illustrated

Bose has shown how by using delicate high magnification recorders, the mechanical resp electrical responses of the so called insensitive plants could be measured and they are found to obey similar laws In addition to the response of plants to these artificial modes of stimulation, the plants are subject to continuous environmental stimulations, like gravity, variation of temperature, of light intensity, humidity, irrigation of the roots etc These result in responses of the plant in the form of growth, ascent of sap, tropic movements, like the opposite bending of the stem and root system of a plant under gravity when placed in a horizontal position, called geotropism, the bending of a plant stem towards light called phototropism, the twisting of a growing stem round a support called mechanotropism He has shown that all mechanical responses shown by plant organs are accompanied by a corresponding electrical disturbance, even where the former is absent, the electric response is always present Further even in the anomalous mechanical bending of plant organs in geotropism, the direction of the electric field relative to the bending remains the same It is always directed from the convex to the concave side By means of the electric probe which was first introduced by him in physiological research, he has tried to localize the particular layers in plant organs responsible for a particular activity For example, in the petiole of *Mimosa pudica*, he identifies the phloem as the channel which is responsible for the transmission of excitation from the pulvinus to the leaf system In young plants, he has localized a geo perceptive layer, and he has tried even to localize in the stem of other young plants a layer through which sap is flowing and by whose pulsatory activity water is propelled from the root to the stem and leaf system, *i e* he postulates a mechanism which plays a role analogous to that of the pulsating heart in the circulation of blood in animals This last finding of Bose lacks independent experimental verification

Bose attempts to interpret all the phenomena associated with the response of plant organs to environmental and artificial stimulations, in terms of a few general laws which can be stated as follows The act of stimulation is transmitted from the place of application to that of response by two kinds of impulses, *viz* as a protoplasmic excitation which gives rise to a mechanical response of contraction and an electrical one of galvanometric negativity, the other is of a hydro mechanical nature giving rise to an erectile response and an electric one of galvanometric positivity Whether the positive response will predominate over the negative one will depend on the conductivity of the intervening tissue, the distance of the place of response from that of stimulation and also on the intensity of stimulation In general with poorly conducting tissues weak stimulation and over large distances, the positive hydraulic impulse predominates over the negative excitatory one Bose made a very ingenious attempt to interpret all the various modes of plant response, including growth, ascent of sap, and tropic movement from these few general principles enunciated by him It cannot be said however that he has been always successful For one thing he did not take into account the chemical processes which intervene between the act of stimulation and the resulting response, and which supply the energy of the responsive movement To give some examples, he assumes that the spontaneous pulsations of the leaflets of *Desmodium gyrans* is due to continuous stimulation received by the plant from its sourrounding, without specifying how the energy of stimulation is stored up in the plant It has been found later that the source of energy of pulsation is derived from the breakdown of carbohydrates formed in the leaflet by photosynthesis In the case of tropic movement of plants, it has been found that certain plant auxins act as chemical mediators in the metabolic processes resulting in the curvature of the plant organs In every case however the direction of the *bio electric field determines the direction in which the* plant organ bends The transmission of physiological excitation in mimosa plant is not a purely physical process but a physicochemical one, with which an irritability substance is associated It is very interesting to recall that in the transmission of excitation in nerve muscle units, a chemical substance acetyl choline acts similarly as a mediator Knowledge of the mechanism of the physicochemical process associated with the transmission of excitation in animal organs has helped to bridge over the controversy on the physico chemical nature of transmission of excitation in Mimosa This arose from Ricca's discovery in 1917, that an 'irritability substance' extracted from Mimosa stem when introduced in the cut stem end of a mimosa branch will produce the collapse of the pulvinus and closure of the leaf system In favourable cases it can even give rise to multiple responses It is also known that acetyl choline produce similar contractile activity when introduced in denervated muscles

Bose along with Lillie belonged to the generation of electro physiologists, who attributed a supreme role to bioelectric potential and to its propagation as excitation current in controlling all biological processes including integration, growth, tropic movements, cell division etc The study of the energetics of such

processes which are based upon chemical metabolism, their control by minute quantities of chemical substances like hormones, vitamins and auxins, had not come into being during their period of active research It must however be pointed out that in many living tissues the essential constituents of metabolic processes, the substrates and the enzymes which act on them, are present side by side, but it requires modification of local ionic concentrations induced by electric excitation either transmitted from a distant region or produced locally, to start or inhibit these chemical reactions

I have attempted to give a consecutive account of the different periods of J C Bose's scientific activities, to show how from a study of coherer effect he passed to investigation of the role of passive films on surface of conductors or semiconductors and crystals in the detection and conversion of electromagnetic radiation into electrical energy Further study led him to the discovery of the similarity of responses in certain types of inorganic models to that found in living tissues This again led him to the study of plant responses He remains still the greatest experimentalist modern India has produced Prof S K Mitra calls him the Indian Faraday

He was an intuitive thinker, who starting from certain inductively arrived principles, attempted to interpret deductively all his experimental results, but not always very successfully He suffered also from the disadvantage of not keeping himself abreast with current scientific literature

I, who have followed his experimental investigations and his theoretical interpretations of their results over a period nearing half a century, of which during the last few years I have made a fairly close study, can say paraphrasing the words used by Rev Stanley Jones in his study of Mahatma Gandhi, that 'I have seen him sometimes go wrong in small matters of interpretation, but now I realize how intuitively great he was in his selection of the larger issues At turning points in the progress of Science, sometimes it is more important to state problems and furnish tools for their investigations, than to give the most correct answer After all, in Science, there is no finality in the solution proposed for any problem The subjects investigated by him in Physics, Biophysics and Plant Physiology still retain their places in the foreground of scientific research, and they have all been advanced by his contributions

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HANDMADE POTTERY OF *RAJBANSIS*

BISWAPADA DASGUPTA
CALCUTTA

IN the course of my work among the *Rajbansis* of North Bengal, in 1940, I came across a number of *Rajbansi* families, engaged in making earthen pots on a fairly large scale at the Ujolkota village, 2 to 3 miles off Bhomradaha, a small railway station in between the railway stations of Dinajpur and Thakurgaon, Eastern Pakistan

The families found to be engaged in making pots, are primarily agricultural and pottery is a secondary means of their livelihood The actual making of pots is entirely confined to the women of these households, the men only help them by bringing suitable earth from the bank of the adjacent river Tangon, by collecting faggots for turning the pots, firing the kiln and selling the pots in the local markets My informants among these families, stated that the income from sale of pots goes to the purchase of clothes, salt, kerosene oil and such other necessities which the produce of land does not suffice to purchase after satisfying the need for food The women of these households were stated to have followed this occupation hereditarily and the wheel had never been used in making these pots The women who were found to make pots stated that they learnt this art from their mothers and other elder women of their households at their early ages (12 to 14 years) They said that they never used the wheel as they are *Kshatriyas* by caste and not *Kumhars* They thus preserve the prestige of their own caste by not using the wheel in their pottery If any one of them uses the wheel, the members of the household she belongs to, will be outcasted at once No such case has however occurred within living memory

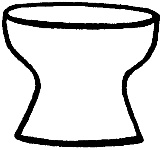
The implements required for making pots are very simple and the absence of the wheel does not seem to stand in the way of making pots on a commercial scale

1 *Chānc* —It is a shallow earthen vessel resem-

Chānc

bling in size and shape the *malsās* It is used while shaping the neck of the pots

2 *Athali* —The *athali* is an earthen vessel It is used while bringing the body of the pot, below the neck to the required shape The mouth of the vessel is wide and the inner wall slightly slopes inwards although the outer one is different It has a distinct rim slightly everted and the middle part is constricted There are *athalis* of different sizes, for pots of different sizes to be made The smallest type of the pots they make, is known as *khuti* For shaping the *khuti* the smallest variety of *athali* is required, *dhoksa*, the



Athāli

next larger size of the pot is fashioned in an *athali* of the next larger variety *Handi*, the next and the largest size of the pots they make, is shaped in the *athali* of the next and the largest variety

3 *Boila* —It is a dabber, made of earth The dabb

Boilā

ing face is more or less flat and the constricted part is meant for the grip while in use

4 *Thokoner Pāthar* —It is an almost round shaped piece of stone with a smooth face, used in beating the body of the pot, inside and below the neck in order to bring the body into the desired shape, placing the pot in an inclined position on the *athali* The smooth face of the *pāthar* comes into contact with the body of the pot inside

5 *Piton* —It is a flat piece of sal wood, required to beat the neck of the pot lightly outside

6 *Pitoner Pāthar* —It is a piece of stone having one of its faces flat and more or less plane It is used in beating the neck lightly, inside and simultaneously with the *piton*, to shape the neck perfectly smooth and plane.

PROCEDURE

Lumps of earth are brought from the bank of the adjacent river Tangon by the male members of the house These lumps are ground over a large piece of gunny bag stretched in the courtyard, when the stone particles and other gritty matters, present in the earth are picked and removed by hand Water is then added to the earth and thoroughly mixed with it and is kneaded into suitable clay for the pots This is done by the women by constantly treading upon it, simultaneously adding water intermittently upto the quantity required The clay thus made is kept wrapped up in the gunny bag (*dhokra*) on which it was made in a shady place

A lump of clay of required quantity, depending on the size of the pot to be made is then put into the *chānc*, after rubbing the inside of the *chānc* with wood ash The clay is then worked into a ball by means of hand The upper and the lower face of the ball are then flattened a little by beating lightly by means of the *dabber* (*boila*) It may be noted that the *dabber* is also smeared with a coating of wood ash previously The clay thus shaped is then raised from the *chānc*, and the *chānc* as well as the *boila* are again smeared thoroughly with wood ash The clay ball with its upper and lower faces flattened is again placed in the *chānc* The flat face is then beaten in the *chānc* by means of the *boila* held at the grip by the right hand

and the *chānc* is made to rotate by means of the left hand In this way, the rounded clay is shaped into a thin circular disc After this the disc is pushed up all round the edges by two hands of the operator, and the disc is also pressed at the same time, as a result

the edge of disc is raised to a considerable height and it then assumes the shape of a cylindrical vessel The edge of the cylinder is then made uniform by means of the hand The cylindrical vessel thus formed is provided with a neck, a small piece of rag (*dhokra*) soaked in water is held by the fingers of the right hand upon the edge of the vessel, where the neck is to be made In between the fingers of the right hand (the thumb pressing the inner wall of the vessel and the rest the corresponding outer wall) the portion of the edge under the soaked rag (*dhokra*) is lightly pressed and simultaneously a rotating motion is induced in the *chāne* by means of the left hand in an anti clockwise direction Consequently the whole portion of the circular edge of the vessel comes under the pressure of the soaked rag held by means of the fingers of the right hand, and the pressure thus imparted to the edge shapes the required neck of the pot to be made

The vessel with flat base and the neck thus formed is kept in a shady place for one day The next day it is placed in the *athali* in an inclined position, the *athali* being previously smeared with sand The portion below the neck is then beaten lightly and carefully with the implement known as *thokoner pāthar*, and in this way the body and the base of the pot is fashioned The body being thus shaped, the neck of the pot is then made plane, by beating lightly the neck already shaped, with the *piton* outside and simultaneously with the *pitoner pāthar* inside at this corresponding positions The *pitoner pāthar* is from time to time dipped in sand and the *piton* is immersed into water, at the same time while in operation The pot with the body and the neck thus shaped is then removed from the *athali* While doing so great care is taken that the shape may not be spoiled

The pots thus shaped are then kept in a shady place for some days (6 to 7 days) before they are taken to the oven for burning The oven for burning the pots comprises of a big hole in the ground At the front of the hole three big jars are placed Two of them are placed in an inverted position leaning against each other from either side of the hole, the third one is placed inverted over the junction of the other two Around the rest of the edge of the hole necks of the broken pots are placed side by side and these are meant for the stands of the new pots to be burnt These new pots are then placed over each stand, and above these pots another set is placed and so on, till a considerable number of new pots are heaped up to be fired in the kiln The faggots are then introduced into the kiln through an opening behind the three big jars placed inverted as previously described, and the fire is regulated from there, this is done intermittently for nearly two to three days till the stock of the pots are burnt perfectly

After the burning is completed, the pots are taken out, the varieties like *khuti*, *dhokra* thus completed, are made ready for sale in the markets The necks of the big jars (*handi*) are painted with a light brown paint From a place, two to three miles off the hamlet, known as Gandhara a kind of brown coloured clay is brought, the clay is boiled with water and the argillaceous colouring matter thus formed is used for painting the neck

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NOBEL LAUREATE IN CHEMISTRY

ARNE Tiselius, the Nobel Prize Winner in Chemistry for the year 1948, was born in Stockholm in 1902 He graduated from the University of Upsala and obtained his Ph D from the same University in 1930 The matter of his thesis "The Moving Boundary Method of Studying the Electrophoresis of Proteins," when published in journals, called the attention of scientists working in the same field Seven years later, in 1937 he published a paper describing the revolutionary new technique for electrophoretic analysis of protein mixtures with an improved apparatus This paper, which was published in the *Transactions of the Faraday Society* disclosed the protein structure of serum, and contributed much in selecting him for the Nobel Prize

Dr Tiselius is only 46, and is the Professor of Bio chemistry of the University of Upsala

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TRAINING IN THE FIELD SCIENCES*

NIRMAL KUMAR BOSE
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AMONG the field sciences we generally consider the following Anthropology, Botany, Geography and Geology, and Zoology, as well as Archaeology There is much in each of these which can be learnt in the museum and the laboratory, but a large part of the student's experience has to be built up by personal observation and training in the field

The arrangements for study in our Universities, which have gradually evolved through decades is very well fitted for such sciences as Physics or Chemistry, but not so much for the field sciences Teachers of the latter group have therefore to supplement the work in the class room by what are called excursions These excursions are generally short in duration and, from experience it might be stated, do not serve to give the student anything more than a nodding acquaintance with the object of his study The result is that, even when the student succeeds in securing a first class degree on the strength of his class room and laboratory work, he does not develop self confidence enough in the sciences under review His sense of responsibility and habit of taking the initiative is often very poorly developed

This is a state of affairs which must be corrected, and the present paper is meant to suggest some means which may prove helpful in this connection

The first difficulty which one notices is that winter is the time when field investigation can be carried on, and this is also the time which is crowded with work in the colleges Administrators of Colleges and Universities have a habit of looking upon field work as a sort of holiday, and therefore wish teachers to thrust excursions into periods of vacation Among vacations, summer is useless for field work while the *Poojahs* occur at a time when rains do not always cease, and the ground is often too wet and *kutcha* roads not in a fit condition for easy movement In many areas, it is also the season for malaria The suggestion is that two or three months spent during winter in company with teachers away from colleges in the field, should be treated as equivalent to class work Teachers may so organize their teaching that special branches of study which have a closer bearing to observations in the field, can be taught on an intensive scale during lecture periods in the midst of the objects themselves

In post graduate classes there should be less of vacation and part of the summer months may be spent in laboratory instead of being wasted, as much of it often is, under present arrangements Vacations are now just blank and meaningless periods of unplanned work, or no work at all, intervening between periods of work, when work itself is not so hard

The second suggestion is that students should do both team work and individual work in the field Thus, if a student of Geography is being taught the art of surveying in the field, a number of them should carry on the work jointly Each must learn how to hold the staff, how to use the chain, the theodolite or the plane table and take his turn at the different things one by one But besides this joint endeavour, each single student should also be allotted a small plot of rough ground, of which he should prepare the map completely by his unaided effort This work will naturally not produce the same quality of work as joint effort will, with the help of specialized apparatus But by trying to map out a region by counting steps and with the help of such simple, portable apparatus as a prismatic compass or a box sextant, the student will learn the art of rapid survey, and thus develop self confidence in a way unattainable by any other means The analogy can naturally be extended to the other sciences, in each of which, a wise balance should be struck between team work and personal work

The third suggestion is that the results of field investigation thus carried out under wise planning and direction should be given adequate recognition while the merit of the student is being judged finally for degree purposes In some of the field sciences, such a practice is current even to day, but the value attached to field records is generally of an inferior order It has got to be stepped up, so that the student may also warm up in his field investigation

The fourth suggestion is designed to increase the feeling of interdependence between the different sciences In such a subject as Human Geography, for example, where we enquire into the question of the interaction between Nature and man's civilization, we immediately find that the aid of co workers who have specialized in soil science or meteorolgy, in botany and zoology and also in economics becomes indispensable A human geographer, instead of playing the part of an amateur botanist and zoologist, in addition to his special enquiries, would do well to seek the co-operation of specialists in those departments in course of his own study In other words, this would mean that when field investigations are being planned, it would be best if it is planned in such a manner that different departments of the University can join in it together They will be in the field at the same time and the same

*Paper read at a discussion meeting on "Training in India for Professional Careers in the Field Sciences" at the Indian Science Congress held at Allahabad on January 4, 1949

place, of course, where they have materials enough to work. While working in this manner, they will naturally conduct investigations independently, but when they meet every evening at the end of the day's work, let them try and help one another in inter related problems. If this becomes organizationally possible, the investigation of separate sciences will often develop a purposiveness which will be of even some amount of academic advantage.

The fifth suggestion is with regard to leadership in research and investigation. In all scientific research, there is always an element of play and of adventure, the desire to battle with difficulties. To break the barriers of darkness and bring a ray of light into the unknown or the little known. Without that, scientific investigation loses its soul. But beyond this purely subjective element in research, there is also another, which often sustains the worker in his difficult days and which also gives a moral tone to his work in the field or the laboratory. This is the feeling of social responsibility. It is not that every problem chosen for investigation should have a practical bias or else become taboo. But the thing is that the worker should also bear the feeling that in his search for Truth, he is not functioning as an investigator, taking delight in personal intellectual satisfaction, and that at public expense, but he is also doing something which is great. And the feeling of greatness comes when one is inwardly assured that the world needs an answer to the questions with which one is struggling to find an answer. For the majority of workers, such a feeling is necessary as a load to give a poise to their scientific investigation. Otherwise their work tends to fritter down into an aimless endeavour, which merely satisfies some idle curiosity, or even a sense of personal vanity. A social sense, rightly introduced, helps to keep the balance much better than otherwise.

But there is another class of workers among whom the sheer joy of enquiry supplies the necessary tone to work. Such students are rare, and, where they are present, the teacher need not worry himself about preventing their research from running to waste. They should be given the 'liberty to play', and the teacher can rest assured that, if the student is of the right type his scientific integrity will create in him the mental discipline necessary for its own fulfilment. The teacher can only become the helpmate of such a student, a friend and guide, not a director. But, for the rest, who are more numerous, it is better to ballast them with a sense of social responsibility, with a demand for 'usefulness'.

There is another matter which should be pointed out in connection with the question of leadership in scientific investigation, whether in the field or the laboratory. Unless the teacher himself feels inspired in his own work of science, he cannot infect others with enthusiasm. Unless one is on fire oneself, one cannot set others on fire.

The reason why some teachers fail in this respect lies occasionally in directions other than academic. The world we live in is dominated by money values. Not that other values do not exist or have ceased to operate in human societies, but money does play an inordinately large part in determining social status in the world of to-day. A man who is well paid feels more satisfied than a less paid man, even when the income of both is above what they need for the satisfaction of needs. Recognition in the Universities unfortunately often comes in the shape of added income. A good teacher in the University is often encouraged by the administrators of the University by being placed in a grade of salaries higher than his last one.

This results in setting up a damaging cycle of movements. A worthy man placed in one of the lower grades loses much of the joy in his work, particularly when he finds people being placed above him not on the score of merits but for extra academic reasons. Of course, there is no justification for keeping any single worker on the border of want. But we are just now referring to scales, both of which are above the level of want, and in which people are shifted from one to another for purposes of encouragement.

This is a feature in our institutions which should best be done away with. A common scale of salaries should be the rule for all. And when encouragement is needed as an incentive, this should come in the form of academic honours and not in terms of added purses. A very desirable way in which the administration can show its appreciation of the worth of a scientist would be to give him more freedom from routine work, and also a greater measure of opportunity given for scientific investigation. Scientists will appreciate that much more than a mere addition to their personal inheritable wealth. A great worker can be very well given the opportunity to retire early on a pension from compulsory teaching work, and kept wholly free to work in his own way by grants exclusively meant for research.

It is difficult to say how far equalization of income, as suggested above will serve its purpose, when the rest of our lives, outside the University, is dominated by 'capitalistic' values. Perhaps the weeds will choke the useful plant out of existence, unless the conditions have changed outside the walls of the University. But if the scientist is worth his salt, if he is true to his profession, he can keep the torch lighted even when the wind is blowing hostile outside. For it is only when such men become more and more numerous, both in the field as well as in the laboratory, that science will come to its rightful place in human life.

The end of the old order must be laid in the souls of men, and when the fire burns brightly in more places than one, it will succeed in reducing to ashes that which chokes its breath to-day, and thus make room for that which alone can make human life better and happier in the end.

Notes and News

THE GREAT COMET OF 1948

Photograph of a new comet has been taken on November 10 with 18 inch schmidt camera at Palomar Observatory The position of the comet at time of picture is $13^h4^m54^s$,—23°14′ Comet is moving south and west in the sky If comet is moving away from sun, as appears to be true, it will probably become fainter Distance from the sun and actual direction it is moving with respect to sun will not be known until its orbit is computed Comet is in constellation of Hydra, south of first magnitude star Spica and very close to third magnitude star Gamma Hydrae Planets Mercury and Venus are just north of comet Tail of comet is about 25 degrees long and brightness of head is about same as second magnitude star First magnitude stars are brightest stars Comet is brightest seen in Northern Hemisphere since 1927 when Skjellerup's comet was visible Nearly 11 months to the day after the discovery in the Southern Hemisphere of Comet 1947n, astronomers below the equator were treated to another brilliant comet which is to be known as the Great Comet of 1948 Like its recent predecessor it became visible only after passing perihelion, but the Northern Hemisphere was fortunate in that the comet was much more favourably placed

Parabolic elements of the comet's orbit computed by astronomers at Cape Observatory place perihelion passage at about October 27 5, 1948, at a distance from the sun of 0 13 astronomical units The orbital inclination is about 22 8 degrees, longitude of perihelion 106°, longitude of ascending node 209 7 (*Sky & Telescope*, December 1948)

NEW MESON

Investigations of mesons have led to the existence of five of these atomic particles which have been generally accepted by nuclear physicists They are the positive and negative mesons of mass 200 times that of the electron, positive and negative mesons of mass 300 and a neutral meson of mass 88 There is also evidence for the existence of three other varieties—positive, negative and neutral mesons of mass 800 to 1,000 Now the discovery of still another meson is reported by Dr Cowan of the California Institute of Technology This particle with a mass of about 10 is by far the lightest meson yet found

In a Wilson cloud chamber photograph of the results of cosmic ray collisions with atoms, made in a plane at an altitude of 27,500 feet, Dr Cowan noticed a highly unusual track The amount of ionization indicated that it was that of a meson, yet the particle had been markedly deflected in collisions with two electrons, indicating that it was extraordinarily light in weight The calculations from its angle of deflection give 11 5 as the upper limit of its mass Its charge is unknown, the photograph yielded no information on that point (*Scientific American*, December 1948)

AMMONIA AS FERTILIZER IN SOIL

Due to the short supply of nitrogenous fertilizers, the bulk of the fertilizers used by American farmers are the sulfate, nitrate, and phosphate of ammonium, and nitrate of calcium and sodium California's crops are irrigated and ammonia is placed in the irrigation water by the method called nitrogation The concentration of ammonia in the irrigation water is usually maintained between 50 and 75 p p m with an upper practical limit of 110 p p m About 15 per cent of the ammonia flashes while passing through the orifice therefore, 85 per cent enters the irrigation water through a perforated pipe as liquid ammonia Average California water contains 80 to 250 p p m calcium and 300 to 600 p p m bicarbonate Ammonia converts the calcium bicarbonate to calcium carbonate, which precipitates and tends to restrict flow in irrigation pipes To prevent this precipitation, a solution of sodium hexametaphosphate is added to the water along with the ammonia After the ammonia has been fixed by base exchange, it is absorbed by bacteria and converted to nitrite Other strains of bacteria convert the nitrite to nitrate which is then absorbed and used by plants

Since nitrogation can only be used during the irrigation season, another method known as nitrojection by which anhydrous ammonia gas is applied directly to the soil during the rainy winter months was developed Nitrogation experiments had shown that soils could fix water solutions of ammonia by ionic base exchange But would directly injected free ammonia be fixed by the soil ? An application of 100 pounds of ammonia gas per acre in a Yolo sandy loam soil was completely fixed within an area of about 2 inches from the point of injection Leaching of the soil column with large volumes of water would not remove the ammonia before nitrification had taken place After nitrification, the nitrate nitrogen was easily moved to plant roots by either irrigation or rain water

The first Nitrojection Ammonia equipment was built in 1939. It was a trailer type unit which was a modification of a kilifer chisel upon which a single cylinder of anhydrous ammonia was mounted. The injection device was a standard cultivator chisel with a quarter inch pipe attached to its back Present trailer type units are designed in several sizes Larger units carry as many as 21 cylinders and have tool bars 39 feet long They are capable of fertilizing 200 acres

a day The recent use of standard offset double disk for nitrojection accomplishes ammonia injection and soil preparation in the same operation. As the vapour pressure of anhydrous ammonia at normal atmospheric temperature is about 175 pounds per square inch, high pressure cylinders which gross between 340 and 345 pounds are used

Nitrojection is now being used in California on a great variety of crops Truck and field crops generally use about 100 pounds of ammonia per acre, but sugar beets often require as much as 150 pounds On tree crops, applications vary from 100 pounds per acre for stone fruits up to 250 pounds for walnuts (*Chemical and Engineering News*, November 1, 1948)

GEOLOGY IN THE SERVICE OF INDIA

The importance of geology in the economic development of the country was emphasized by Dr W D West, presiding at the forty fourth annual meeting of the Mining, Geological and Metallurgical Institute of India held in Calcutta on January 28, 1949

Dr West said it needed the impact of two World Wars to convince those in authority that industrial progress of the country depended on the development of its mineral wealth, for which the services of geologists were necessary.

When it was realized that India's annual production of minerals, including building materials, was estimated at over Rs 56 crores, that the value of metallurgical products, such as pig iron and steel, was Rs 26 crores a year and that much of the electrical power of the country was obtained from coal, it would be recognized that the science and practice of geology, upon which the development of the mineral industry was directly based, was of paramount importance

Pointing out that the geological map of India on the scale of one inch to one mile should be completed, Dr West said that, excluding the areas covered by alluvium and the Deccan lavas, there still remained about 290,000 sq miles of land to be surveyed on this scale If 50 geologists were employed exclusively on this work, it could be completed in 16 years Upon the execution of such a map would depend proper exploitation of the country's mineral wealth, utilization of its ground water resources, location and design of dams, alignment of railways and the study of soils

Dr West outlined the work of the Geological Survey of India, which had not only expanded in size but had extended its scope of activities by setting up new sections for engineering geology and ground water investigations, for geophysical exploration, for mineral prospecting and for drilling Circle offices of the department had been opened in Madras, Bombay, Nagpur, Lucknow and Puri to enable it to keep in touch with Provincial Governments and to help them in their development programmes

Presenting the annual report, the Honorary Secretary (Dr. P K Ghosh), said the total number of all classes of members at the end of the year was 715, being the highest on record The Institute has taken a practical interest in the many problems facing the mineral industry and a 'Directory of Indian Mines and Metals' would shortly be published A new series of publications entitled *Notes and News* was inaugurated, the first issue of which appeared in September last

The following award of Institute's prizes and medals was announced

The Government of India Prize of Rs 500/- and *Institute's Silver medal* to P I A Narayanan and J Fleming for their paper on beneficiation of Lead-Zinc ore of Zawar, *Silver Medal* to Dr E Spencer for his paper on manganese ore deposits of Jamda valley and a *Bronze Medal* to Sri S K Borooah for his paper on chromite deposits of Nausahi (Keonjhar), Orissa

The following were elected office bearers for the year 1949

President—Mr L J Barraclough, *Editor of Transactions*—Dr M S Krishnan, *Honorary Treasurer*—Mr V P Sondhi, and *Honorary Secretary*—Dr P K Ghosh

INDIAN INSTITUTE OF CHEMICAL ENGINEERS

At the First Annual General Meeting of the Indian Institute of Chemical Engineers held on January 1 2, 1949 at Allahabad, Dr H L Roy, the Founder President of the Institute delivered the Presidential address in which he analysed the educational facilities in Chemical Engineering at the eight leading institutions of this country and made an impassioned plea for evolving a uniform system of education best suited to the industrial needs of this country He mentioned that the All-India Council of Technical Education had taken a right lead in this direction and he urged his follow educationists to take immediate steps to implement the recommendations for uniformity in Chemical Engineering education Dr Roy, then proceeded to give details of the training facilities afforded to young engineers by leading industrial organisations of the world like the General Electric Co He contrasted this with conditions in India where, except in one or two organisations like the Tata's no systematic training for young chemical engineers was imparted

Referring to the role of the Indian Chemical Engineers, Dr Roy, remarked that it was their primary duty to modernise the Chemical Industry of this country to expand production and make the existing units yield better efficiencies of production. He laid particular emphasis on unit operations and their control by instrumentation and cost analysis He also urged the industrialists and the technicians to devote their utmost attention to the quality of production and gave an outline of the methods of quality control in industrial establishments.

In conclusion Dr. Roy, gave an account of the employment trends in the chemical engineering profession in the U S A. and in India In the interests of efficient operation of public utility concerns and basic industries which are expected to come under State control, Dr Roy, urged that the Government should realise the importance of this specialised branch of engineering in which our country is making a slow but sure beginning and should take speedy measures to utilise the young technicians to the utmost benefit of the country

The following were duly elected office bearers of the Council for the year 1949 Dr H L Roy, *President*, Dr H E Eduljee and Sri S Ganapathy, *Hony Secretaries*

URANIUM PROSPECTS GOOD

The Chairman of the U S Atomic Energy Commission has announced recently that prospects are excellent for a continuous supply of uranium in the world for an indefinite time to come An unwarranted impression that a short age of uranium would drastically limit the possibilities of atomic energy had been caused by estimates that known reserves of uranium would last perhaps only 30 years or not more than 40 Estimates of the total world supply of uranium had run from 30,000 tons to 500,000 tons, 17 times as much Estimates of rates of potential consumption of the fissionable material derived from uranium had also varied considerably The Atomic Energy Commission wished to state that those estimates of a short lived atomic enterprise were not correct and that there is no basis in fact for those statements about extremely limited uranium ore supplies (*The Chemical Age*, January 1, 1949)

CERAMIC COATED MOLYBDENUM

It is reported from the U S National Bureau of Standards that molybdenum with a specially designed ceramic coating offers a promising combination for high temperature service Most of the usual heat resistant alloys begin to melt when heated within the temperature range of 2400° to 2600°F Only such scarce metals as platinum and iridium, melting at 3180° and 4260°F respectively, have sufficient resistance to oxidation at high temperatures to be used without protection

The ceramic coatings developed to provide this protection to molybdenum are supplied in the form of water suspension or "slips" to cleaned specimens of the metal either by dipping or spraying After drying, the pieces are fired at a temperature of 2150°F in oxygen-free atmospheres The furance is the only special equipment needed beyond that normally used in applying ceramic coatings

A number of coatings were prepared at the bureau Some of these were outstanding in resistance to thermal shock, while others had good resistance to high temperatures One of the better coatings, M-13-33, consisted of (1) a base coat of a low expansion frit with 20 per cent zirconia added, (2) a cover coat containing 95 per cent zirconia, and (3) a seal coat consisting of a thin application of the same composition as the base coat

In an air atmosphere at 1650°F unprotected molybdenum sheet was found to decrease 0 02 in in thickness in 30 min There was no decrease, however, for ceramic coated molybdenum heated for 70 hours under the same conditions At a gas temperature 3500°F, giving a surface temperature on the specimen of 2600°F or more, only short time protection of the molybdenum was attained

An immediate application of these ceramic coatings is the protection of molybdenum pitot tubes which are built into the nozzle end of ram-jet engines used for pilotless air-craft These pitot tubes, which are subjected to a gas temperature of about 3000°F are expendable and need not last over five minutes The ceramic coated molybdenum gives short time protection at these high temperatures and so the need remains for coatings which can be used for high temperature applications where longer service life is required (*The Chemical Age*, January 1, 1949)

SPREADING D.D T ON SNOW

A new mosquito fighting technique has been developed to make life more endurable in the Far North U S Department of Agriculture entomologists, in cooperation with the Army and with Canadian scientists, have found that spraying D D T on Artic snow from airplanes is an effective means for keeping down the hordes of blood thirsty insects that often make work out of doors impossible in the Far North.

As soon as the snow has melted and formed a wet sheet among the plants of the tundra, arriving mosquitoes are accustomed to lay their eggs Now they find their nursery a death trap for both themselves and their young ones

One advantage of the new technique is its relatively low cost Sprinkled from low flying airplanes, one pound of D D T is sufficient to treat 10 acres (*Science News Letter*, December 4, 1948)

MORE VITAMIN B

At least a dozen different B vitamins exist Ten of them can be obtained in pure crystalline form These are thiamine, riboflavin, nicotinic acid, vitamin B_6, pantothenic acid, choline, biotin, inositol, para-aminobenzoic acid, and folic acid

The common food still remains, however, the best source of these vitamins in practical nutrition. One reason is that food supplies all the unknown ones along with the known ones. The vitamins B occur in different proportions in different foods, and also in different

commercial vitamin concentrates Oat meal, for example, contains more than twice the amount of thiamin that liver contains, but only one-twentieth the amount of riboflavin that is in liver Commercial concentrates are valuable for treating specific deficiencies of one or another of the vitamin B But unless properly used, they give no greater security of supplying all the vitamins B one needs than the proper combination of natural food (*Science News Letter*, December 4, 1948)

NEW LIGHT ON TOXINS

The action of toxins is till now a mystery, though its powerful effects are well known One milligram of diphtheria toxin, for example, would kill about 10 tons of guinea pigs Toxins are proteins and their toxic effects cannot be explained inany simple terms of chemical poisoning It must be related to some way in which the protein molecule as a whole exerts some specific biological effects—for example, by inhibiting the action of an enzyme

A M Pappenheimer of New York has recently found out a significant clue The diphtheria toxin is excreted by the bacteria in company with a substance belonging to a class known to chemists as the *porphyrins* Porphyrins are complex compounds of carbon, hydrogen, and nitrogen, which play very important roles in the vital processes of both plants and animals Pappenheimer showed that the yield of toxin begins to decrease if the concentration of iron rises above a certain point Exact measurements show that for every four atoms of iron added above this limit one molecule of toxin fails to appear At the same time four molecules of porphyrin fail to appear This indicates that the bacterial cell excretes one molecule of toxin for every four molecules of porphyrin As the excretion of both toxin and porphyrin decreases when the amount of iron available is increased, it must be supposed that the excess iron becomes locked up inside the bacterial cell in the form of *haem*, the iron containing porphyrin The increased retention of *haem* inside the cell seems to be controlled by an enzyme called *cytochrome b*, which plays an essential part in the respiration of living cells

Putting all these facts together, Pappenheimer has suggested the following theory The diphtheria bacillus as part of its normal life process synthesises *cytochrome b*, and as a preliminary step it must manufacture both the protein part of the enzyme and the porphyrin If, then, it has a sufficient supply of iron, the iron and the porphyrin go to form *haem* and the *haem* is joined to the protein to produce the *cytochrome b* enzyme But if there is a shortage of iron, the bacillus cannot finish the job It is left with the protein part and the porphyrin, which, for lack of iron, cannot turn into the required enzyme Since the protein part and the porphyrin are biologically useless alone, they are then excreted And the protein part, according to the theory, is the diphtheria toxin

In other words the diphtheria toxin is the protein part of the enzyme *cytochrome b* as it occurs in animals, or at least is very similar to it And *cytochrome b* is vital to the life of all animals On that basis Pappenheimer suggests the following theory as to how the toxin kills The cells of an animal must have some sort of automatic adjusting mechanism whose function is to detect any deficiency of the vital enzyme *cytochrome b*, and put in train the chemical processes that would rectify the deficiency, or correspondingly stop these processes when there is sufficient enzyme present But the toxin which is excreted by the diphtheria bacillus and finds its way into the cell of an infected animal resembles *cytochrome b* so closely that the adjusting mechanism in the cell responds to it just as if it were *cytochrome b* Thus a plentiful supply of diphtheria toxin is mistaken by the cell for a plentiful supply of *cytochrome b* Production of the latter is stopped and the animal suffers, and possibly dies, from a lack of it (*Discovery*, December 1948)

UNESCO TO SEND EDUCATIONAL MISSION TO AFGHANISTAN

A contract providing for a Unesco Educational Mission to Afghanistan was arrived at by H E Sardar Najib Ullah Khan, the Afghanistan Minister of Education, and Dr Julian Huxley, Director General of the United Nations Educational, Scientific and Cultural Organisation, in Beirut

This contract, the first of its kind to be entered into by Unesco with a Member State, provides for a survey of elementary and secondary education with special emphasis on technical and vocational education

The Mission will visit Afghanistan during the spring of 1949 and will remain there for a period of nearly three months It will then publish a report on its work

The Mission will include one head and two members to be appointed by Unesco, as well as experts selected by the Afghanistan Government

UNESCO LAUNCHES BOOK COUPON SCHEME

The Unesco book coupon scheme, devised to overcome foreign exchange difficulties, will enable educational and scientific institutions of "soft" currency countries to buy publications from "hard" currency countries, while making payment in their own national currency

About $50,000 will be a donation by Unesco to Austria, China, Czechoslovakia, Greece, Hungary, Italy Indonesia, Iran, the Philippines and Poland The additional $100,000 worth of coupons will be put on sale in China, Czechoslovakia, France, India, Poland and the United Kingdom

The coupon scheme, launched on a one-year experimental basis, practically amounts to the intro-

duction of an international medium of exchange, with Unesco supplying the necessary "hard" currency backing to make the project work Booksellers who accept those book coupons for payment will be repaid by Unesco in their respective national currencies

SEARCH FOR OIL IN PAKISTAN

Depth of the Lakhra (Sind) test well, where the Burmah Oil Co (Pakistan Concessions) Ltd are drilling in search of possible oil bearing structures, exceeds 3,250 feet

Progress in drilling is slow owing to the unusually hard formations encountered in this area

The 14¾-inch diameter hole now being drilled will go to a depth of about 8,000 feet, where 10¾-inch casing will be run Final objective of the test well is more than 10,000 feet

The formations so far tested have not yielded any indication of oil

Lakhra, on the edge of the Sind desert, is about 35 miles north-west of Hyderabad and about 170 miles by road north east of Karachi, Pakistan

ASSOCIATION OF SCIENTIFIC WORKERS OF INDIA

The Second Annual General Meeting of the Association of Scientific Workers of India was held on January 4, 1949 at Allahabad with Dr T N Seth, Professor of Medical Chemistry, Medical College, Patna, in the chair

Presenting the annual report for the year 1948, Dr B C Guha (General Secretary) said that the branches of the Association were preparing a register of unemployed scientific workers and helping in providing employment to them The Association had also taken up certain cases where the scientific workers had been threatened with retrenchment It would shortly be submitting a memorandum to different employers of scientific workers, particularly, the Government, in regard to the conditions of service and amenities granted to scientific workers

Continuing he said, the Association was now affiliated with the World Federation of Scientific Workers, which held its first historic General Assembly at Prague in September last year and adopted a charter of rights and obligations for the scientific workers

On different national and international issues, the Indian Association was in touch with sister associations in the United States, Canada, England, France Poland and other countries

The meeting called upon the Government to remedy the situation caused by the "widespread unemployment and mal employment of scientific workers in the country," and to utilise the service on good jobs of State financed overseas scholars on return to India

The following National Executive of the Association was elected for the year 1949 *President*—Hon'ble Pandit Jawaharlal Nehru, *General Secretaries*—Dr P K Kichlu and Mr C R Mitra

FRANS VERDOORN

Dr Frans Verdoorn, Managing Editor of *Chronica Botanica*, whose appointment as Director of the Los Angeles State and County Arboretum at Arcadia, California, was announced earlier (See *Science and Culture*, December, 1948, p 242) has planned to develop a modern arboretum and botanical garden at Arcadia with various educational and research departments

Dr Verdoorn will continue to edit *Chronica Botanica* and related serials Some of these will be published in the future by the Los Angeles State and County Arboretum, others will be transferred to a commercial publisher

Dr Verdoorn, a native of the Netherlands, came to the U S A in 1940 Formerly known for his work in Cryptogamic Botany, he has lately been occupied chiefly with historical studies and international relations work He was an assistant at the Buitenzorg Botanic Gardens, Java, in the 1930's and has been a Research Fellow at Harvard University since 1940 During the war years he did much work on Latin America and South East Asia for various government agencies He received the first Mary Soper Pope Medal in 1946, (See *Science and Culture, 12*, 433, 1947) and has just been appointed Chairman of the International Phytohistorical Committee

ANNOUNCEMENTS

Dr P Parija of the Indian Educational Service (retired) and former Vice Chancellor, Utkal University, is elected Pro Vice Chancellor, Banaras Hindu University, Banaras

Dr S M Sircar, Lecturer in Botany, Calcutta University, is appointed Professor of Agricultural Botany, Central College of Agriculture, New Delhi A distinguished plant physiologist, Dr Sircar's work on the relation between *P* supply and nitrogen metabolism in rice plants has got important bearing on the application of nitrogen fertilizers for paddy His investigations on vernalization and photoperiodism of rice have indicated a new line of research for crop improvement in India He was invited by the *Chronica Botanica* to contribute a discussion for a symposium on "vernalization and photoperiodism" with special reference to the tropics published recently (See *Lotsya, 1*, 1948)

Earlier he served for some time as a Reader in Botany and Head of the Department of Biology, Dacca University, and was also a Honorary Secretary of the Botanical Society of Bengal and Science Club, Calcutta

The following were elected as office-bearers of the Indian Botanical Society for the year 1949, at the

Annual General Meeting of the Society held at Allahabad on January 2 last *President* and *Editor in-Chief* Prof G P Mazumdar, *Business Manager* and *Treasurer* Dr S P Agharkar, *Secretary* Dr T S Mahabale

Prof D D Kosambi of the Tata Institute of Fundamental Research, Bombay, has been granted a UNESCO Fellowship to work on new types of electronic calculating machines, for setting up a modern Calculating Laboratory in Asia

A subscription of 500 dollars from the UNESCO, on the recommendation of the Union Internationale d'Histoire des Sciences, has been granted to the Indian Chemical Society for the publication of a History of Hindu Chemistry

The Burmah Oil Company (India Concessions) Limited has made a grant to the Bose Research Institute, Calcutta, to further the research work on micro fossils as an aid to the age determination of sedimentary strata, with special reference to the microbotanical remains in rocks from the Salt Range The research will also deal with the age of the Punjab Saline Series The investigation will be carried out under the direction of Sri A K Ghosh (See *Science and Culture*, *13*, p 423, 1948)

ACKNOWLEDGEMENT

The article entitled "Can Agriculture be Mechanized"? published elsewhere in this issue is translated from an article published in *Science et Vie*, May 1947

ERRATUM

In February 1949 issue, P 331, Column 2, line 9, *read* C von Furer Haimendorf *for* Christoph von Haimender

BOOK REVIEWS

The Back and Its Disorders—By Philip Lewin, M D Published by the McGraw Hill Book Company, Inc , New York Price $2 50

This book deals in a popular way the simple methods of helping the cure of backache which is almost a common ailment amongst the people The ways and means of preventing disorders of the back is dealt with in a simple manner The anatomy, topography and physiology of the book are explained in lucid language, and the sites of injury or defects in the back are narrated

The modern methods of treatment like antibiotics, X-ray and physical therapy treatment with up to-date equipments are dealt with in such a way that carefully trained doctor can help a good deal the persons suffering from backache If the doctor cannot cure a case he can at least give relief to the patient by studying this book

The causative factors of backache are well classified, whether it is due to nervous factor, bacterial infections, pain in the sarcoiliac region or defect in the intervertebral disc, or tumours of the vertebrae or due to overweight

The importance of good posture and regular care of the back like teeth and skin is fairly delineated The author has practically given a new idea regarding the disorders of the back and its cure and treatment in a nice and illustrative way

N D

Practical Psychiatry and Mental Hygiene—By Samuel W Hartwell M D McGraw Hill Book Co , Inc , London & New York Price $3 75

The book is one of the "Series in Nursing" books brought out by Messrs McGraw Hill Inc The author, a well known psychiatrist, has made an admirable attempt to present to his student nurses the fruits of his wide experience He has eminently succeeded in focussing the attention of the students on the main symptoms of the neuroses and the psychoses and the ways of dealing with them The style is lucid and clear throughout and what has struck the reviewer most is the extreme caution with which the author has proceeded in presenting the different theories He has been particularly careful to guard the students against following false clues and forming wrong notions about the relative importance of the etiological factors of mental diseases The nurses on whom lies the heavy responsibility of attending to mental patients are expected to possess a good knowledge of the external behaviours of such patients and of their mental states and conditions which find expressions in such behaviours The present volume will be of immense help to them in acquiring such knowledge and they may confidently accept it as a safe and sure guide in the task of preparing themselves for the humane work to which they are going to dedicate themselves

To the reviewer the only weak part in the book seems to be part 2, where the author has sought to

delineate the different methods of approach to the problems of mental disease It could have been much simplified and abridged This weakness, however, does not in the least affect the usefulness of the volume I am confident that the book will have a large circulation not only amongst the student nurses for whom it is primarily meant but also amongst all students of psychiatry and practising psychiatrists

S C M

The Failure of Metals by Fatigue—Proceedings of a symposium held in the University of Melbourne, Dec 2nd to 6th 1946 Demy 8vo pp xvi+505, with illustrations Melbourne Univ Press, Carlton N 3, Victoria, Australia (42/ sh)

The earliest recorded series of experiments on the effect of repeated stresses is that by Fairbrain in 1864 His work was followed by Wohler in 1870 in which the first comprehensive investigation on fatigue testing was made, covering a period of some 12 years The next important work on the subject was carried out by Bauschinger in 1868, followed by numerous other workers, the most prominent among them being Gough in England and Moore and Kommers in America Some 15 years after the publication of their classic work (H J Gough "The Fatigue of Metals," 1926, H F Moore & J B Kommers, "The Fatigue of Metals", 1927), the staff of Battelle Memorial Institute U S A brought out a treatise on "Prevention of the Failure of Metals, under Repeated Stress," (Wiley, 1941), including in it the most comprehensive bibliography of over 900 references, ever published in English Since then, and during the war years, information on fatigue accumulated, without being disseminated, due to certain restrictions, till 1947, when the Melbourne University Press, published this symposium, which forms one of the most unique in the development of engineering science Dr Gough F R S who writes the foreword states that in organizing a comprehensive discussion on the subject of fatigue concerned with the design, development or maintenance of machines, structures and components subjected to cyclic stresses, the University of Melbourne's Faculty of Engineering has rendered a signal service to a wide circle of scientists and engineers

Five Technical Sessions were held and thirty papers contributed and discussed, of which 21 were written in Australia, 6 in Britain and 3 in America The wide scope of the subjects is best gathered from the preliminary remarks made in the first sessions by Prof Sexton, Dean of the Faculty of Engineering, Univ of Melbourne, when he was called upon to welcome the delegates by the Chairman of the Symposium, Prof J Neill Greenwood, Research Professor of Metallurgy, Univ of Melbourne The subject, "The Failure of Metals by Fatigue" said Prof Sexton "was selected because it was of wide interest to almost every type of engineer and metallurgist" The mechanical engineer is concerned with rapidly moving machine parts subject to millions of repetitions of high stress with metals often at high temperatures There are several papers which deal with this subject and in which the mechanical engineer will find interest, such as, "The Design of Cylindrical Shafts Subjected to Fluctuating Loading", "Fatigue of Bolts & Studs," "Notch Sensitivity of Metals," and "Conditions Leading to Fatigue Failure in Sleeve Bearings" The civil engineer deals with structures where many changes of moving load occur with attendant vibrations and variations in stress To him, papers on subjects like "Fatigue Tests on Four Welded H Beams", and "Failures of Railway Materials by Fatigue" are of unusual interest The problems of fatigue failure in electric transmission lines, which are a constant source of worry to an electric engineer, are ably dealt with in three papers *viz*, "Some Practical Aspects of Wire Fatigue in Aerial Telephone Lines based on an Analysis of Wire Breakages", "The Vibration of Telephone Line Wires", and "Fatigue Failures of Lead Sheathing of Telephone Cables" The aeronautical engineer has difficult problems in keeping the weights of engines and framework to a minimum and at the same time in ensuring adequate distribution of material to prevent destructive vibrations and fatigue failure Papers on "Fatigue Problems Associated with Aircraft Materials", "The Factors Contributing to Fatigue Failure in Aircraft", "Fatigue Problems in the Gas Turbine Aero Engine," and others cover a wide field in aeronautical sciences An unusually interesting paper for a chemical engineer is "The Electrochemistry of Corrosion Fatigue," by Dr U R Evans, who occupies one of the newly created posts of Reader in the Science of Metallic Corrosion, Cambridge University The author together with his colleagues has demonstrated that the corrosion fatigue of steel, because of the electrochemical nature of the corrosion process, can be reduced or prevented by suitable cathodic protection, a point which this reviewer also discussed in this journal some time back ("Stress Corrosion", Dec 1945, p 305, and "Cathodic Protection of Pipe Lines", Oct 1946, p 177) The importance of physical metallurgy in fatigue is well brought to light in a number of papers such as "Types of Fatigue Failures in The Steel Industry", "The Prevention of Fatigue Failures in Metal Parts by Shot Peening", and "Composition & Physical Properties of Steel in Relation to Fatigue" In addition to these papers the subject of fatigue stress measurement and investigation receives adequate importance in such papers as "Photo Elasticity and Stress Concentration", "Methods of Investigating the Fatigue Properties of Materials", "The Measurement of Dynamic Strain" and "The Detection of Fatigue Cracks" Of all the papers, the reviewer thinks that the first three constitute the best in the symposium, for their wide scope, clear and lucid style and authoritative and advancing outlook The first on "The Failure of Metals by Fatigue", by Prof Greenwood, describes the physical features of fatigue failure and forms as it were a springboard for future research on the subject.

The second paper on "Metallography, Fatigue of Metals and Conventional Stress Analysis" by H F. Moore, Emeritus Research Professor of Engineering Materials, Univ of Illinois, and doyen of the profession, informs an illuminating, historical account of the subject, and one which is of great interest to engineers and scientists alike The third paper on "Theories of the Mechanism of Fatigue Failure", is written by Dr W Boas, of the Univ of Melbourne and one time an associate of Schmid, and Fribourg and co author of "Kristallplastizitat" An ardent leader in the development of crystal plasticity and the science of metal physics, the author vividly describes in this paper the development of ideas on fatigue failure and X ray diffraction methods and discusses them in the light of modern theories of Dehlinger, Orowan, and others, including the statistical theories of fatigue failure, proposed by Afanasev in Russia, and referred by this reviewer in one of his previous papers ("Atomic Structure of Engineering Metals", 'SCIENCE & CULTURE, Feb 1947, p 388)

The book is published on good paper with clear photographs and illustrations The reviewer's only regret is that a work of this nature which has an inestimable value to engineers, metallurgists and other scientists should have included a good index for reference to a large number of topics hidden within the various papers

S K G

A 62 Guide for Modular Coordination—By Myron W Adams and Prentice Broadley 290 pages, 314 illustrations, 9″×12″ Published by Modular Service Association, Addison Wesley Press Inc, Kendall Square Building, Cambridge 42, Mass, U S A ($10 00)

"The existing house structure was mostly developed before the industrial age, and grew out of the materials and methods, and social standards of earlier centuries The structure is physically sound but not well adapted to recent technical advances in materials and applied mechanics" Thus wrote Albert Farewell Bemis, American originator of the modern structural method of cubical module design, in his classic treatise "The Evolving House,—Rational Design," Vol III (The Technology Press, M T I, U S A, 1933) The fundamental principle laid down by Bemis is, that of all the geometrical figures, the cube has the greatest abstract potentiality, which if properly applied should meet all the requirements of practical design When considered as a unit of space measurement, the cube defines volume, and is therefore capable of controlling the plan and elevation of any house and thereby its entire structural layout Secondly the cube is symmetrical with respect to each of its three axial planes, this symmetry being especially useful in the design of jointing Thirdly, its six surfaces can control the location and dimensions of composite parts within the module or adjoining it The principle of cubical module is quite simple and like many other fundamental conceptions is exemplified in a number of processes such as in the weaving process in tapestry, brickwork, tiles and other building materials In most of the modern forms of building construction, the chief attention has upto now been directed towards the use of newer types of materials, and newer processes of joining and fabrication In order that the requirements of modern engineering and industry are adequately met, a totally new conception of structural design is warranted It is this conception of progressive outlook, which forms the basis of the theory of cubical module propounded by Bemis and his collaborators In his treatise referred to above the author gave a very complete theoretical discussion, but avoided any implication of restriction either to building products, or practice in particular Realising a need of transferring, the theoretical ideas and implications of this form of design, The American Standards Association (sponsored by the American Institute of Architects and The Producers Council Inc, U S A and with the project staff provided by Modular Service Association), set up a project (A62) to lay down the standards of modular units for building purposes The outcome of their efforts is seen in the present volume under review, which forms a guide for the coordination of dimensions of building materials and equipment The work is justly dedicated to Bemis, and prepared under the able guidance of America's leading architects, and engineers

There are 12 Chapters, and 3 Appendices The first chapter deals in general with the broad principles of the subject and explains clearly the importance of dimensional coordination in building work Chapters 2 to 11, discuss the application of the principle to different classes of work, such as masonry, facing tile, floors, wooden frame, doors, windows, stairs and glass blocks As a concrete example of the ideas, the last chapter contains photographs of the architects' drawings for a New York Health Centre, in which are included a variety of modular products

The flexibility of the system in applying the module as size increment is clearly described in Appendix A, while Appendices B & C deal with height coordination tables, and some American standards, respectively The adoption of a 4 inch module as the standard American unit forms the keynote of the whole modular conception, while its applicability in units not exactly multiples of four, but allowing for clearances and tolerances to suit practical construction needs, forms one of the most admirable property of this system

Profusely illustrated with accurate scale drawings, lavishly produced and lucidly written in conformity with the usual American texts on architecture, this volume forms a notable addition to the scanty literature on the architectural science of modular coordination

S K G.

LETTERS TO THE EDITOR

[*The Editors are not responsible for the views expressed in the letters*]

BUREAU OF PLANT INDUSTRY

It is inspiring to note that Indian scientists are becoming increasingly conscious of the need of reorganization of agriculture in India on more modern, wider, and effective lines

Chopra has advocated the establishment of a Bureau of Plant Industry and several other collaborating agencies on the model of the U S Department of Agriculture [1] Botanical Society of Bengal,[2] Calcutta, has similarly urged upon the Governments of Bengal and of the Indian Union

Reading these accounts with respect to context, there appears to exist some confusion of thought The "Bureau of Plant Industry" (of U S A) is neither an advisory body nor one concerned principally with Drug industry Its sphere of activities is very much wider and deals with innumerable agricultural crops "Division of Drug and Related Plants" was only one of the 18 divisions into which the activities of the Bureau are divided, since August, 1946 the Drug Division has been amalgamated with the Tobacco Division under the present name of Division of Tobacco, Medicinal, and Special Crops In fact, the name of the Bureau even has long been changed to "The Bureau of Plant Industry, Soils and Agricultural Engineering" in response to Executive Order 9063, February 23, 1943 *

Though in itself the Bureau of Plant Industry, Soils, and Agricultural Engineering is a huge organization, it is just one of the several similar (or even bigger) Bureaus and other constituent agencies under the U S Department of Agriculture §

The writer with his background of service experiences of several years' work in a provincial agriculture department in India has, during the past year and a half, tried to study the organization of agricultural research, teaching, and extension work (*i e*, bringing the laboratory results to use by the practical farmers) through several visits to the Headquarters and Field Stations of several of the Bureaus and agencies of the U S Department of Agriculture, sometimes working with them for periods, discussing matters with Bureau officials, deans of Agricultural Colleges and State Agricultural Experiment Stations He is convinced of the dire need and imperative necessity of thorough reorganization of agricultural research, teaching and extension (=demonstration) work in our Indian Union if we, as a nation, are to forge ahead And the sooner it is realized that the United States is as much, if not more, an agricultural giant as in industry, the sooner we try to ascertain the reasons behind such progress and harness the knowledge, the quicker shall we be able to provide enough food, raise our economy, our health and the standard of life in our country, which is still 75 per cent agricultural

Lastly, nothing can be done better than to quote from "The Report of the Secretary of Agriculture 1947" of U S A, recently published, to show how application of modern scientific and technical knowledge can revolutionize the agriculture of a country

"Survey of American agriculture emphasizes recent improvements which amount practically to a technical revolution In 1946 the production was 33 per cent greater than the average for the years 1935 39 About three quarters of the increase resulted from technological developments, only one fourth may be attributed to the exceptionally favourable weather of the wartime and early postwar years"

Calculated in money, three fourths of this 33 per cent increase represents 7 billion dollars or about 2300 crores of Indian rupees' increase in the national (agricultural) income of U S A, just within the span of a decade We can well imagine how much we can increase our agricultural production by applying modern methods on our fertilizer hungry soils, eagerly awaiting to respond with better seeds, manure, and a little technical handling

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30 4 1948

[1] SCIENCE & CULTURE, *13, Indian Sci Cong Suppl* pp 8 19, 1948

[2] " " " (Symposium note on) Indigenous Medicinal Plants, pp. 286

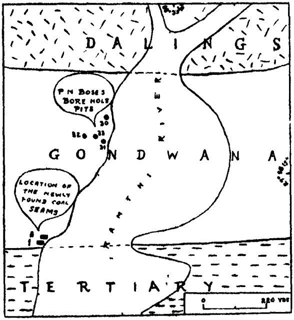
* Under several Acts, passed in 1936, 1938, and 1940, research in agricultural engineering, chemical control of weeds, soil fertility, and soil microbiology work, soil chemistry and soil physics, and the soil survey work were transferred to this Bureau

§ For proper understanding of the entire agricultural setup as it exists in U S A on Federal level, a frame work of U.S Department of Agriculture in details will appear in a subsequent issue of this journal —ED., *Sci & Cul*

TWO NEW COAL SEAMS IN THE HIMALAYAN TERRAIN

Between 1889-90, Bose, while prospecting for coal at the foot-hills of the Himalayas in the Darjeeling district, detected workable coal seams in the Gondwana formation in the Tista-Chel Reserved Forests between

the Lish and Ramthi rivers The field is situated north of Bagrakote railway station (88° 85′E 27° 53′ N) within four miles reach The Bagrakote station is on the Bengal plain The "Himalaya Coal and Mineral Industries Ltd " are now raising coal from the seams included within the area between Bagrakote Kalimpong road on the east and Lish river on the west



Map of Ramthi river area

A report on this area together with a geological map on 8″= 1 mile scale was published by Bose[1] He gave also an account in detail of the economic, geological and other important aspects of the coal seams between Ramthi and Lish rivers In his map he traced many coal seams and many bore hole pits made by him were also located in that map

The persistent character of some of the seams over long distances as shown by him in his map is rather questionable Observations by the present authors on distinct outcrops exposed by workings in the colliery area has shown that most of the seams are quite impersistent, occurring as lenses and pinching out within short distances

Besides they have come across two coal seams on the western bank of the Ramthi river, which have not been recorded by Bose and which are in quality as good as those now being worked in the colliery areas These two seams together with another carbonaceous shale band are situated within about 20 yds from the Tertiary Gondwana boundary In the map of Mr Bose 4 bore hole pits are located further N N E about 440 yds off, the two seams mentioned above seems to have been missed by him, evidently because his attention was focussed more strongly on the ground in the immediate vicinity of the Bagrakote Kalimpong road

The first seam from the Tertiary Gondwana boundary is 12 feet thick and the second one about 15 feet The dip is high nearly 60 towards N N E The latter seam is, however, highly intruded by igneous rocks which has burnt a good deal of coal at the contacts

The prime difficulties in working these seams will be (i) Transportations etc , (ii) Quarrying is possible to a limited extent, and underground mining will require efficient skill of mining engineers to dig at such a high gradient with tremendous overload of sandstone hill mass over it, (iii) Cost of mining will be very high, (iv) Inspite of all these difficulties, even if they are mined underground, in the rainy seasons there will be heavy rush of river waters within the mines and will completely disrupt the workings and (v) The friable nature of the Himalayan coal will be an additional factor for roof collapse

Proximate analysis (see Table below) of the coals from the 1st and 2nd seams on Ramthi together with two analysis of coals No 6B and No 4 quarries of Dalingkot Colliery area will give a comparative idea as to their qualities

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20 9 1948

[1] Bose P N—*Rec Geo Surv Ind* 23 part 4 1890

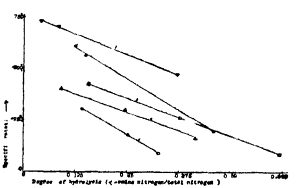
PROXIMATE ANALYSIS CALCULATED TO COAL DRIED AT ROOM TEMPERATURE

	Analysis by S K De			Analysis by P Kar
	Ramthi Seam No 1	Q 6B Dalingkot	Q 4 Dalingkot	Ramthi Seam No 2
Moisture	3 0857%	1 78%	2 24%	4 239%
Volatile matter (less moisture)	7 8239%	17·08%	2 27%	8 011%
Fixed carbon	66 5517%	58·65%	31 82%	54 028%
Ash	22 6447%	22 481%	63 67%	37 059%
Total	100 00	100 00	100·00	100 00
Quality of Ash	Colour reddish, slightly fusible, ferruginous	White, powdery, non-fusible	White, non-fusible	
Coking quality	Non caking Coal	Non-caking	Non-caking	
Fixed carbon calculated on ash free basis	85 91%	75·65%	87 61%	

OPTICAL SPECIFICITY OF PROTEIN HYDROLYSATES

Natural tissues exhibit ordinarily a high degree of optical specificity Diverse in their configurational individuality and residual aminoacids the proteins and their degradation products should cause a distinct and characteristic path on the scale of asymmetry for each protein But as the laevo acids of a protein hydrolysate is found to be metabolised in the system,[1] it would be of interest to study the optical specificity in protein hydrolysates that are now being largely used in therapy This may also be a measure of ascertaining the nature as well as the nutritive value of the protein hydrolysate

Accordingly casein, gelatin, beaf meat, egg albumin (separated from its globulin component) and raw ox liver were digested with pepsin, papain and trypsin at 50°C for 48 hours and changes in their optical rotation with the degree of hydrolysis were recorded (*Vide* Fig 1) with the Smidt and Haensch polarimeter The



1 Gelatin, 2 Casein, 3 Albumin, 4 Meat 5 Ox Liver

Fig 1

hydrolysate in each case was treated with equal volume of 5 per cent trichloracetic acid at room temperature (32°C-33°C) and the filtrate was used for the determination of total nitrogen α amino nitrogen (Vanslyke manometric method) and the optical rotation The degree of hydrolysis expressed in the graph was the ratio between the α amino nitrogen and the total nitrogen The specific rotation was calculated from the observed rotation by the formula[2]

$$= \frac{100 \times \text{observed rotation (degrees)}}{\text{length of the tube (dm)} \times \text{gm } N_2 \text{ per } 100 \text{ c c}}$$

It would appear from the graph (Fig 1) that each of the protein hydrolysates exhibits roughly a linear relationship between optical rotation and the degree of hydrolysis Further each follows a distinct and characteristic path of its own Decrease of optical rotation with the progress of hydrolysis of proteins may be due to either increase of symmetry alone in the fragmented molecules or the increased formation of antipodes or due to both Absence of identity in the angles of slopes in various hydrolysates may be due to the factors cited above A similar study is being made with acid hydrolysates and their difference would show the influence of the enzymatic hydrolysis in tending to maintain the asymmetric specificity of the mother protein in the hydrolysate The details of the work would be published elsewhere

N Ray

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18 11-1948

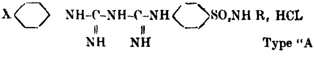
[1] Chibnall *et al*, *Biochem J*; *34*, 285, 1940

[2] Winnick and Greenberg, *J Biol Chem* *137*, 429, 1941.

STUDIES IN ANTIMALARIALS:

SOME N[1] ARYL N[5] HETEROCYCLIC BIGUANIDES

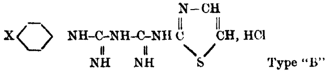
With the discovery of Paludrine (N^1 p chloro phenyl N isopropyl biguanide) as a potent antimalarial[1], sufficient interest has been developed in the field of substituted biguanide derivatives as potential anti malarials The replacement of N^1 p chlorophenyl group of paludrine with substituted phenanthryl[2] and 6 methoxy 8 quinolyl groups[3] resulted in compounds which were found to be inactive when tested against experimental malaria It is therefore likely that an aryl group (particularly p chlorophenyl ring) is essential for activity in this class of compound The N^5 isopropyl group of paludrine has been replaced by substituted aryls[1], p phenylarsonic acid[4], quinolyl groups[5,6] p phenylsulphonamide (substituted or otherwise)[7,8] (Type A) and m phenyl (5 chloro 2 pyrimidyl) sulphonamide,[8a] out of which the last two types of compounds when tested against avian (*p gallinaceum*)[9] and semian (*P knowlesi*)[10] malarias have shown moderate suppressive antimalarial activity As an extension of our previous work it was thought worth while to prepare "sulphonamide free" analogues of sulpha biguanides (Type A) previously reported, where the effect of a therapeutically important heterocyclic ring systems directly attached to N^5-position of an N^1 arylbiguanide could be studied Consequently compounds of type B were synthesised by the interaction of required aryl-cynoguanidine with 2 aminothiazole hydrochloride and were obtained as white crystalline hydrochloride salts



Type "A"

R = 2 thiazolyl, 2-pyrimidyl, 4 methyl 2 pyrimidyl, H, etc

X H, Cl, Br, etc



m p in °C of compounds of type B

X = H, 260° decomp , X = Cl, 294° decomp , X = Br, 183°, X = I, 285° decomp , X = CH_3, 202°, X = CH_3O, 307° decomp , X = NO_2, 240° decomp, X = H, 2 3 dimethyl, 251°C

One of the compounds of type B (where X = Cl) when tested avian malaria was found to be slightly active though toxic Attempts to bring about similar condensations by the interaction of p chloro phenylcyanoguanidine with the following amino heterocyclics by (i) refluxing the reactants in suitable solvents, (ii) fusing them together or (iii) by using copper sulphate for the isolation of the biguanide as the metal lic complex, were unsuccessful

4 Methyl 2 aminothiazole 6 Methyl 2 aminothiazole, 5 amino 2 chloro 7 methoxy acridine (atebrin base) 2 amino 6 hydroxy 4 methyl pyrimidine, 2 amino 6 chloro 4 methyl pyrimidine and 2 amino 4 methyl pyrimidine Similar failures of reactions have also been reported by May *et al*[3] and Gupta & Guha[6] These may be due to the selective nature of the amino groups in the above cases The problem is being further investigated

Our thanks are due to Dr B H Iyer for his keen interest and to the Indian Research Fund Association for the award of a fellowship to one of us (*H L B*)

Organic Chemistry Laboratories, Indian Institute of Science, Bangalore 27 11 1948

H L BAMI
P C GUHA

1 Curd & Rose, *J Chem Soc*, 729 1946
2 May *J Org Chem*, *12* 437, 443, 1947
3 May *et al*, *ibid*, 869
4 Roy, Iyer & Guha, *Current Science*, *17*, 126, 1948
5 Gupta, Iyer & Guha, *ibid*, 53
6 Gupta & Guha *ibid*, 185, 238
7 Bami, Iyer & Guha, *J Indian Inst Sci*, *29A*, 15, 1947, (cf *Current Science*, *16*, 254, 1947)
8 *Indem*, *Ibid*, 30*A*, 1, 1948, (cf *Current Science* *17* 90 1948)
8A *Indem*, *ibid*, 9 (cf *Nature*, *162*, 146, 1948)
9 *Indem*, *Current Science*, *16*, 386, 1947
10 *Personal Comunication*

A CASE OF TERATOLOGY IN *ERIOCAULON*

An interesting case of abnormality has been recently noticed by us in *Eriocaulon quinquangulare* Linn The specimens were collected by Dr H F Mooney, from Motijharan, (alt 600 ft), Sambalpur Orissa on February 7, 1948 (Mooney 2989 in Herb Dehra Dun *et* Herb Kew) In his forwarding letter to the senior author, Dr Mooney wrote regarding his specimens as follows

"I am sending you herewith a rather curious *Eriocaulon* which I collected a few days ago close to my bungalow here in a muddy patch of ground which has yielded some quite interesting plants in the past Is it a form or variety of *E quinquangulare* which is abundant all over the ground where this specimen was found, or is it a separate species? I returned Fyson's *Eriocaulons* the day before I found this plant, but I do not recollect having seen anything like it recorded therein. The secondary peduncled heads, forming a partial umbel are decidedly curious and I have seen nothing like them This specimen occurs scattered here and there throughout the area occupied by *E quinquangulare* and there do not appear to be any intermediate forms "

The flowers of *Eriocaulon*, as is well known, are arranged in capitula It was noticed, that some of

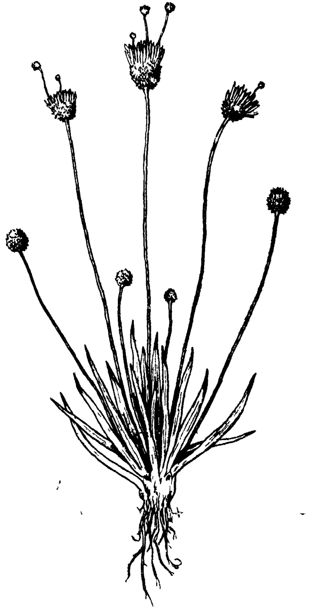


Fig 1

the capitula have developed additional bracts. These bracts are scarious, more or less subulate, and longer

than the normal bracts At the axils of these bracts a few secondary, 10 15 mm long peduncles are developed, which terminate in secondary capitula The secondary capitula are much smaller in size when compared to the primary or normal capitula The lower half of the normal capitulum contains the usual normal florets (Fig 1) It appears that the formation of the secondary bracts precedes the formation of the secondary capitula In the Herbarium of the Royal Botanic Gardens, Kew there are two old sheets of *E quinquangulare* Linn collected in South India (without precise locality) which exhibit the development of secondary bracts, but not secondary capitula One of these is referred to in Wallich's catalogue No 7279 as *E martianum* Wall ex Koen, and the other was given the significant name *E argenteum* Mart var *proliferum* Wight The latter name is recorded in Wight's catalogue 2367b, 1833

Foliar or floral proliferations are of frequent occurrence in nature and these are usually induced by various factors In the garden varieties of *Calendula* (*Compositae*), similar floral proliferation has been noticed So far we have been unable to trace any record of teratology in the genus *Eriocaulon*, although, Penzig[1] has suggested that in the allied genus *Paepalanthus* (*Eriocaulaceae*), some degree of proliferation specially in the species of the section *Platycaulon* is of frequent occurrence In the numerous cases of abnormalities recorded by Masters[2] and Worsdell[3] there is also no record from the genus *Eriocaulon*

It may not be futile to advance an explanation for the present abnormality We feel that this was induced by the peculiarities of a very wet environment with perhaps some flowing water Neither of us has, however, seen the plants in the field and our suggestion should therefore be only provisional It is likely that the secondary capitula when detached, may be able to establish the plant in the substratum in view of their secondary peduncles but only intensive field observations can give us more precise information on this aspect

Acknowledgement is due to Sri V Narayanaswami, of the Botanical Survey of India, Calcutta, who kindly examined the specimens and confirmed that they are *E quinquangulare* Linn

Forest Research Institute
Dehra Dun, and
Royal Botanic Gardens, Kew
M B Raizada
D Chatterjee
6-12-1948

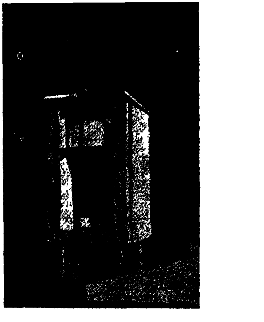
[1] Penzig, O Pflanzen Teratologie, Berlin, p 418, 1922
[2] Masters, M T, Vegetable Teratology, London, 869
[3] Worsdell, W. C, Principles of Plant Teratology, London 1916.

DESIGN OF AN ISOTHERMIC CONTAINER FOR TRANSPORT OF SEMEN

In order to transport semen to different places in India for artificial insemination of animals, investigations were undertaken to design a light, shatter-proof container which would maintain a temperature within the range of 5 to 10°C for about 4 days Preliminary results indicated that with further heat insulation, the ordinary 3 pint thermosflask may serve the purpose Of the different available insulation materials experimented upon, asbestos proved to be the best For obtaining the required temperature range within the container, a second thermosflask containing solidified benzene was placed inside the 3 pint one Arrangements were made by means of a specially designed socket stand and a spring fitted rubber cork so that the smaller thermosflask, 1½" in diameter and 7" in height, made no lateral movement when the ice melted The semen ampoules were placed in a long glass tube with an interior cotton wrapping in solidified benzene The wrapping was to prevent any cold shock to the sperms

The complete system was designed as follows

Asbestos boards were fixed to both the exterior and interior of a wooden frame work so as to leave an effective air gap of ½" on each side of the box A spring mounted aluminium bucket was fitted to the bottom plate to hold the thermosflask The bottom plate was made of a wooden board with interior asbestos insulation and was fitted to the container by



means of screws The top cover, made similarly, had a spring suspended asbestos groove made from asbestos sheets so as to fit the neck of the thermosflask

Thus the thermosflask was prevented from having any lateral motion The top cover was fixed to the frame-work by a big screw operating in a horizontal rod resting on the top cover The entire structure again rested on four spring controlled stands The photograph shows the assembly of the container Asbestos boards from one side of the box were taken out for showing the details

Results of an experiment to investigate the efficiency of the designed container are given below

Atmos temp °C	°F	Wt of ice Grms	Time Hours	Temp rise of Benzene °C	Semen Motility %
•				(Initial 5°C)	(Initial 80%)
37	98 6	850	72	1	60
			78	5	60
			92	11	50

Benzene vapour has deleterious action on the sperms even when the semen is kept in stoppered vials, still it is advisable to use glass ampoules

About 20 lbs in weight, the container has been designed rigorously shatterproof and chances of damage to itself and to its contents are almost eliminated It can be used throughout the year, except of course, during hottest summer days in certain parts of the country Under average North Indian summer conditions the time of storage will vary from 72 to 100 hours, while in winter, it will be from 120 to 144 hours

The author is indebted to the Late Prof P N Ghosh and to Prof S N Bose of the University College of Science & Technology, Calcutta for providing laboratory facilities for this work

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Indian Veterinary Research Institute,
Izatnagar, 21-12-1948

PARA AMPHIBOLITES AND ASSOCIATED CALC, SILICATE ROCKS IN PAHARGORA, EAST MANBHUM

The calc-granulites and schists with interbanded amphibolites occur to the north of Pahargora, East Manbhum, Bihar ($73\frac{1}{16}$,23°37′ N, 86°44′30″ E approx) as a comparatively persistent band for a length of about two miles A second band of similar dimensions occurs near Keliaboni Kachbel and a third, almost wholly an amphibolite, occurs to its south They occur in a conformable sequence with sillimanite mica schists and gneisses, quartz mica schists etc

The calc-granulite has the appearance, in hand specimens, of a white marble, more or less granoblastic with green streaks of tremolite imparting a faint gneissosity, and at places with a sort of glomero-porphyritic concentration of considerably big crystals of tremolite and calcite and occasionally also diopside The rock has been crossed, at times, by pegmatites and granite veins of various dimensions, and near thin granite veins excessively coarse grained rocks with big crystals of diopside and/or tremolite have been developed The tremolite diopside granulite and almost pure calcite marble with varying proportions of these two chief constituents form the dominant types and are seen to vary widely in composition, both laterally and along depth Lenticular patches of amphibolite schists within the granulite is very common, and in more than one instance the granulite or the gneiss is seen, along the strike, to pass gradually and imperceptibly into amphibolites In some cases, however, the latter forms more or less distinct units, though their boundaries are never sharp enough The gradual and irregular passage of one type into the other in all directions is seen even in a small compass The amphibolites show a peculiar planar schistosity (rather closely cleaved) that distinguishes it, remarkably in hand specimens, from amphibolites associated and connected with noritic rocks that occur elsewhere in the region

Petrography On the mineral contents, the rocks may be described under three groups, as follows (*i*) Diopside tremolite granulites and gneisses with or without calcite and with alternate, thin, impersistent bands of almost pure calcite marble passing on through (*ii*) hornblende diopside rocks into (*iii*) amphibolites

The amphibolites differ from ortho amphibolites, in its feldspars being more calcic (An_{82}, XΛAb Tw =30° 5, ve) and the mica being phlogopite The associated rocks have the following mineral contents diopside, tremolite, calcite, plagioclase, microcline, quartz, sphene, phlogopite, scapolite and clinozoisite, in different proportions throughout the mass The plagioclase is An_{74}(r i_s > Ne of quartz, $2V_{\infty}$=88°)

Sometimes plagioclases of above composition, or more calcic feldspars are found to be surrounded by a rim of albite Calcite cores with frayed and gradational border within plagioclase is also not rare It is evident that sodic plagioclase has reacted with calcite to give more basic plagioclase, cores of which merge into the albite rims

The addition of K, Na, Si, Al etc is proved by the presence of microcline and of pegmatites containing albite (β=1 526 ± 002, γ = slightly greater than 1 5303, +ve) or microcline, besides the texture described above

Chemical composition of the amphibolite shows some abnormality in having a high CaO and K_2O and low Fe″ and Fe‴ Inspite of this striking difference, however, the computed Niggli values fall well within the eruptive field (section IV, with c/fm 2 03 and qz -16) The difference from ortho amphibolites is accounted for by the presence of bytownitic plagioclase instead of the common andesinic feldspar, phlogopite instead of biotite, and aluminous iron-free amphibole

Analyses from different parts of the exposure show a more or less constant relationship between CaO and MgO and between the alkalies The difference in phases in different parts of the mass has for its explanation an original difference in composition and not an unequal entry of foreign elements Hornblende and tremolite are seen to bear a more or less complementary relation Towards the contact of amphibolite and granulite the former is seen to be composed of hornblende and diopside and the latter of tremolite and diopside The composition of tremolite is, according to Schaller, $H_2Ca_2Mg_5(SiO_3)_8$[1] Presence of aluminous impurities, thus, would explain the formation of hornblende instead of tremolite

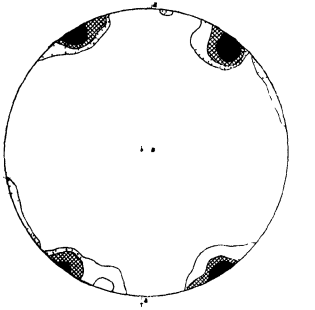

Fig 1

The hornblende fabric of an amphibolite was studied The *ac* hornblende fabric[2] of a specimen gave four maxima symmetrical about *ab* nearly on the *ac*, 30° to 35° from *a* (Fig 1) The (010) planes of hornblende are thus found to be nearly parallel to *ab* and the crystallographic 'c' is parallel to *b* With most hornblende crystals it is seen that the (010) is the flattest surface The fabric appears to be dimensional and is perhaps a re crystallisation fabric controlled by the incipient *ab* plane Sander[3] describes a hornblende orientation where the crystallographic 'c' axis is parallel to *b* and (100) lies on the *ab* plane The study is still in progress

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S Sen
S Raychaudhuri
B Mukherjee

[1] Bowen, N. L. and Posnjak, E., *Amer Journ Sci* 22, No 129, 1931
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VERNALIZATION AND PHOTO PERIODISM IN AFGHANISTAN WHEATS

Afghanistan is a typical dry mountainous country with scanty annual rainfall of about 16 inches. The hill tops are mostly barren otherwise studded with xerophytic type of vegetation It is estimated that about half of the tilled lands in Afghanistan is under unirrigated crops The riverine belts are however, rich in cultivated crops, where sufficient water is available and is capable of being distributed for irrigation purposes over stretches of cultivable land This difficult and poorly developed mountainous country holds in its folds, striking riches of varieties, displaying an astonishing diversity of the most important crop plants of the old world Vavilov has studied the distribution of important crop types according to the altitudinal limits and have found wheat to be the most important as well as widely distributed crop in Afghanistan The topographical nature of the country is determined by Hindu kush crossing through Afghanistan The northern high mountainous regions sloping gradually towards the southern regions of the country This mountainous nature of the country with isolated valleys and mountain slopes with variable rapid changing climatic conditions, soil and moisture contents, are found to contain a large number of different Ecotypes of wheat crop and other cereals, which have not yet been disturbed by human hands Vavilov[4] has collected and described about 60 established botanical varieties of soft wheats (*Triticum vulgare*), and another 50 varieties of club wheats (*Triticum compactum*) Afghanistan, therefore, possesses such a diversity of wheat varieties as perhaps no country in the world The club and soft wheats are distributed in parallel series and according to Vavilov, the world centre of the origin of these wheats with complex of 42 chromosomes are to be sought in these regions of Afghanistan and adjacent countries Afghanistan, therefore, is an ideal place for study of the natural distribution of different varieties of wheat in relation to their environmental factors

Therefore a scheme of study was initiated to collect the different varieties from the different regions and to investigate the effect of temperature and light periods on the growth and development under controlled experimental conditions The work of this kind has not so far been done in Afghanistan nor such results are available on different Afghan varieties of wheat from other countries as Germany[4] and Russia[5] (U S S R) where the different specimens of Afghan wheats have been taken through their respective expeditions in Afghanistan The author[1,2,3] has done such investigations on Indian cereals and other crops and the opportunity of staying in Afghanistan has been utilised to extend such investigations with materials collected in Afghanistan The plan and the nature of the work require a long term period and for the present was divided into the following aspects

(i) Collection of different varieties of wheat from different regions of Afghanistan.

(*ii*) Their systematic study, identification and classification

(*iii*) The established botanical varieties to be sown in the Kabul area under (*a*) natural conditions of sowing before the snowfall and (*b*) in the beginning of spring after being vernalized

(*iv*) The effect of different post sowing photo periods to find the minimum conditions required for the initiation of the develop mental stages both in spring and winter varieties of wheats

and (*v*) To test the response of the different varie ties by growing them in different environ- mental conditions as prevailing in India for their propagation

The preliminary work done in course of last two cropping seasons is briefly reported here Though a large number of varieties were collected yet investi gations were conducted only on 3 varieties of soft wheats (*Triticum vulgare*) and 3 varieties of club wheats (*Triticum compactum*) found widely distributed in Kabul valley area and identified according to the clas sification of Vavilov[4]

Triticum vulgare	*Triticum compactum*
var *graecum*	var *rufulum*
Var *erythrospermum*	var *rubrum*
var *erythroleucon*	var *splendens*

Normal sowing is generally done in October November, the sprouted seedlings remain under low temp varying in the end (Jan Feb) near about freez ing point to snowfall In this period the seedlings get their low temp requirement The seedlings begin to grow and give out tillers after the snow begins to melt from March onwards The ear emergence be gins from May onwards and harvesting is done from July onwards The seedlings get their light period requirements in the form of increasing long day periods up to a maximum of 18 hours light periods alternating with 6 hours dark period Any alteration in the se- quence of temperature and light conditions bring about significant changes in the growth and develop ment of the different varieties Therefore a set was sown in laboratory as well as under field conditions in the end of March (in the beginning of the spring sea- son) after being vernalized for 30 days under snow kept in an ice box The other set was sown without ver nalization as control Later, when the seedlings were one month old they were given different light periods for 8 weeks and then allowed to grow under natural conditions of long day lengths The results are tabu lated below giving the number of days required for ear emergence from the time of sowing

From the results it is clear that in late sow ing, when the required cold temp was not available to the seedlings, developmental stages leading to ear emergence are not completed as shown by control

TABLE

Showing the number of days required for ear emergence in different varieties under vernalization and photoperiodic treatments

Varieties	Treatment	Post sowing light periods of varying day lengths				Remarks
		Control	12 hours	10 hours	8 hours	
T vulgare:— var *graecum*	Vernalized	95 4	97 8	127 5	Disintegrates	Behaves like a winter var
	Control	No Ear	No Ear	No Ear		
var *erythrospermum*	Ver	90 0	98 5	120 4	Survives but no tiller formation	ditto
	Control	No Ear	No Ear	No Ear		
var *erythroleucon*	Ver	85 0	88 6	128 5	No Ear emerg	Behaves like a spring var
	Control	90 4	98 4	129 5	No Ear emerg	
T compactum:— var *rufulum*	Ver	98 8	100 0	124 5	No Ear emerg	Behaves like a spring var
	Control	85 7	98 2	130 7	No Ear emerg,	
var *rubrum*	Ver	120 5	102 5	No Ear	No Tiller	Behaves like a winter var
	Control	No Ear	No Ear	No ear	,,	
var *splendens*	Ver	98 7	112 0	,	Disintegrates	,,
	Control	No Ear	No Ear	,,	,,	,,

experiments, but they are completed under a combination of low temp (vernalization) and post sowing light periods of 12 hours or more alternating with dark periods Certain varieties, however, respond to a modification of the factors under a limited range and it is possible to classify varieties according to their temp and light conditions into winter and spring varieties from amongst the Afghan varieties None of the varieties could stand a short period of 8 hours, under which the seedlings either disintegrated or remained in a very poorly developed condition without tiller formation A light period of 10 hours seems to be the minimum requirement for the photodevelopmental phases to be completed, provided the other factor (cold temp) had been available in the early stage The temp range and the photo range vary in different varieties and it is possible under certain limits to fix up a critical range of these factors in case of each established botanical variety

Further work is still in progress and detailed reports would be published elsewhere

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SYNTHESIS OF AMINOACIDS PART I

A novel synthesis of dl Methionine

The reaction of hydrazoic acid with substituted β keto esters affords a convenient way to synthesise α-aminoacids in excellent yields[1] and was employed for the preparation of glycine, leucine, α aminobutyric acid, α-aminoamylacetic acid, phenylalaline and others from the corresponding acetoacetic ester derivatives in 80-98% yield The present communication describes the extension of this reaction to the synthesis of dl methionine

In response to a request by Prof S R Bose we prepared a sample of methionine on the first hand by the route involving the classical method[2] In view of the nature of the starting materials at our disposal the method seemed to be somewhat laborious In an attempt to discover an easier method we were led to the following procedure involving two simple operations starting fron β chloroethylmethyl sulphide.

$$\text{(I)}\quad CH_3S\,CH_2CH_2Cl \xrightarrow[80-85\%]{[CH_3CH_2CHCO_2Et]^- \, Na^+}$$

$$\text{(II)}\quad CH_3SCH_2CH_2\underset{}{\overset{\overset{\displaystyle COCH_3}{|}}{C}}HCO_2Et$$

$$\xrightarrow{HN_3,\ \text{Hydrolysis}} \underset{\text{Methionine}}{} CH_3S\,CH_2CH_2\underset{\underset{\displaystyle NH_2}{|}}{CH}-CO_2H$$

β chloroethylmethyl sulphide (I) was reacted with the sodioaceto aceticester to yield β methylthioethylacetoacetate (II) b p 135 40/5mm The latter was treated with hydrazoic acid in absolute benzene in presence of concentrated sulphuric acid The product on hydrolysis with dilute sulphuric acid and removal of sulphuric acid by calcium carbonate followed by extraction with isobutyl alcohol yielded methionine m p 275 8°

We place on record our deep sense of gratitude to Prof S N Bose for his guidance and encouragement We are indebted to Dr P K Bose, Director, Lac Research Institute, Namkum (Ranchi), for the gift of some of the chemicals required for this investigation

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SCIENCE AND CULTURE

A Monthly Journal of Natural and Cultural Sciences

Vol 14 | APRIL 1949 | No. 10

BIOLOGICAL RESEARCH AND TEACHING

IT may appear paradoxical, but still it is a fact that man's interest in nature has been in proportion to the distance between him and the subject of his study The objects furthest removed from him have always exercised a strong fascination on his mind The sun, moon stars and their movements attracted his attention even in pre historic times and the science of astronomy was one of the earliest to come into being The present age is little different We are all thrilled by discoveries of new galaxies, stars, comets, cosmic rays and other phenomena associated with heavenly bodies and news about them appear in our daily papers Man has worked very hard and spent immense money and energy in the attempt to discover the laws governing the physical universe He has shown keen interest in every aspect of inorganic nature, which has finally led to the discovery of the structure of the atom and even the utilization of the energy bound up within it

We have, on the other hand, shown much less inclination to pursue the sciences concerned with the study of living organisms Biological sciences, therefore, all the world over with the possible exception of medicine perhaps, are in a comparatively less advanced condition and occupy a lowly status Yet, the future welfare and happiness of mankind are ultimately bound up with the pursuit and cultivation of these sciences. As Sir Henry Tizzard stressed in his recent Presidential Address to the British Association at Brighton, "Whatever new comforts and luxuries may be provided in future by the advancement of physical science, it is on the development of biological sciences that the peace and prosperity of the world will largely depend" * Similar views have also been expressed in recent times by Dr Julian Huxley, Sir John Boyd Orr and several other distinguished savants.

Viewed in this light, we have read with much interest Prof. A. C. Joshi's Presidential Address, a large part of which is printed elsewhere in this issue The address draws attention to the backward state of biological research and teaching in the country in several directions and suggests suitable measures to raise its level

Science has now come to be generally recognized as the growing point of human advance Therefore, it is increasingly essential that it should function in a balanced manner For this purpose, financial support of such character is needed for the different branches so that the result should be a well proportioned and balanced growth of science as a whole On account of the strong incentive of profit and defence requirements of the different countries, however, the world is far away from this ideal condition and science is unable to accomplish all that is expected of it

Considerable progress has been made in India during the last few years, through the efforts of the Council of Scientific and Industrial Research and other organizations to create opportunities for research both of a fundamental and applied character in several branches of physical and chemical sciences and about a dozen National Laboratories are being set up in the different parts of the country The biological sciences, however, have received no attention so far Professor Joshi draws pointed attention to this lop sided growth of science in the country It is a painful surprise for us to learn that importance of such departments of biology as physiology, ecology, genetics, microbiology, systematics, etc are not looked from modern developmental points of view and adequate facilities for their respective development do not exist in the country The potential danger of such a situation should be obvious to any one, when it is realized that the solution of several urgent problems facing the country, such as the rapidly growing population, soil erosion and conservation, poor yield and improvement of the fertility of the soil, feeding of the hungry millions, raising the standard of their health and physical and social well-being largely depends upon the cultivation and application of these very branches of biology.

*See SCIENCE AND CULTURE, 14, [illegible], 1949.

Now that we have a Ministry of Scientific Research, we expect it to look into such malfunctioning of science and strongly urge the Government to take early steps to set up a Biological Research Council and establish new laboratories assigned with the task of fostering research in all those branches of biology which have not received adequate attention so far and whose development is essential to the progress and prosperity of the country [1]

As an illustration, we suggest that there ought to be at least one *Institute of Genetics*, where a co ordinated and team work on the Genetics of plants, animals and human beings and research work of a fundamental nature may be carried out At the present, work in these lines is carried out in some of the universities and other institutes but where progress is often stifled due to lack of funds The proposed Biological Research Council should also foster researches in those places where a tradition has already been built up They have also to take up the question of the reorganization and expansion of the existing institutes carrying on biological investigations

The adoption of the policy of colonial development has brought home to the Government of United Kingdom the necessity of trained biologists for the execution of their plans Many problems of Indian economy and sociology are of the same nature or at least akin to those that prevail in colonial territories and may be solved if tackled along similar lines The Royal Society Commonwealth (Empire) Science Conference, held in June July, 1946, seriously considered this question and laid great stress on the training of biologists in systematics and organization and expansion of biological surveys (See SCIENCE AND CULTURE, *12* 115 124, 1946) We appear however, to have done very little in this direction The plans for the expansion of the Botanical and Zoological Surveys have not been executed so far and it is reported that they have been shelved for some time under the stress of the present financial difficulties [2] The country had to face similar financial crises several times during the last forty years and on every such occasion the axe has fallen heavily on the biological surveys The Botanical Survey particularly has suffered much on this account and at present hardly exists

Both the Botanical Survey and the Zoological Survey, at present, function under the Ministry of Agriculture,[3] where they are merely regarded as useless appendages and receive a step motherly treatment Their importance to the scientific advancement of the nation has never been suitably recognized though survey work is essential for any scientific development From their very nature these surveys are of long term duration and are not likely to yield any immediate economic gains, so that whenever expenditure has to be cut down these surveys are the first to receive the attention of retrenchment officers With the establishment of Biological Research Council, it is hoped that these surveys would receive their due attention We urge the government to consider this question seriously

The duty of the Government, and especially of the Ministry of Scientific Research, is to see that science develops in the country in a balanced order, but at the same time we expect the universities and teachers of biology also shoulder their share of the responsibility Prof Joshi in his address has also pointed out some glaring shortcomings in biological teaching in the country A similar situation perhaps also exists in the field of Zoology The necessity of suitable changes in the teaching and syllabuses of these subjects appears urgent and should receive the early attention of all concerned [4] If biological research and teaching in the universities could be suitably co ordinated with research in the fields of agriculture, forestry, pharmaceutics, sociology etc , not only will the cause of these special applied subjects be advanced but biological studies themselves will also receive a much needed internal stimulus

Biology teachers should also realise the great value of biology in the cultural sphere If the vast masses of humanity could be made to understand that everything in this world—plants, animals, food, clothes, houses, means of transport, language and every other mental and social activities of man himself—is always undergoing transformation, it will do immense good to the world and save us from a large number of petty factions and controversies Such a broad outlook can be created most effectively by the

[1] To ensure co ordination, proper development of research under all heads is essential, and the Industrial Research Planning Committee in 1945 recommended the setting up in India of a National Research Council Prof A V Hill, who was invited by the Government of India, also emphasized the need for a Central organization which should cater for and co ordinate all the main categories of scientific research affecting the welfare of the country (in addition to the underlying 'pure' academic research), *viz*, (1) medicine and public health, (2) agriculture and animal husbandry, (3) industry, (4) surveys and natural resources, (5) engineering and (6) the defence services These recommendations are yet to be implemented by the Ministry of Scientific Research

[2] We notice, however, that the Standing Finance Committee of the Finance Ministry has been discriminating over priorities for development and research schemes and in spite of financial stringency they have recently approved the setting up of a Central Potato Research Institute at Patna, and proposals to intensify research in wheat rust prevention in India were finalized.

[3] These two surveys were formerly under the portfolio of the Member in Charge of Education, Health and Lands. When in 1946, these Departments were split under separate Ministers, these surveys were put under the Ministry of Agriculture.

[4] The Atomic Energy Commission working under the Ministry of Scientific Research has recently stressed the importance of revising syllabuses in Physics, Chemistry and Mathematics and steps have already been taken to suggest suitable changes A similar action may be taken up with respect to Biological Sciences as soon as the Biological Research Council is brought into existence, to look into the syllabuses of Biological Sciences.

teaching of the theory of organic evolution The story of the gradual unfolding of life from simple beginnings to highly complex forms and the final evolution of man and his gradual rise to the present position of pre eminence in the organic world will prove a very healthy corrective to minds steeped in ignorance, narrowness and religious fanaticism At the moment, however, organic evolution is being taught even to biology students in a most perfunctory manner and is some times almost neglected

Our distinguished contemporary (*Nature*, *162*, 868, 1948) recently commented on the acute jealousies and antagonisms to which biological sciences appear to give birth and the consequent difficulty of persuading any group of biologists to agree on a common policy This is as true of India as of any other part of the World Biology like religion appears to arouse considerable passions We take this opportunity, however, to remind Indian Biologists that on the progress of their science depends to a considerable extent the welfare, prosperity and future happiness of this country, and they should jointly endeavour to promote their science on right lines so that its present shortcomings are over come as soon as possible and it assumes the proper status among Indian sciences that is rightly its due

BOTANY IN INDIA · PRESENT POSITION AND PROSPECTS*

A C JOSHI
HOSHIARPUR, EAST PUNJAB

THE achievement of independence by our country has suddenly given Indian Science a new status and greatly raised it in public esteem Everyone appears to look to science for the solution of the country's difficulties It now depends entirely on us what we make of the opportunities that have opened out before us Obviously we have to do some self examination and reflect on what we have been doing in the past, what have been our shortcomings, what we should do now to overcome them, and how we can play a more effective role in the development and progress of the country

NEGLECT OF BIOLOGICAL SCIENCES

The moment one begins to think about the present status of Botany in India, one is inevitably led to consider the general neglect of biological sciences It is true that this feature is neither characteristic of nor confined only to our country, but how harmful it can be in the long run to the progress and happiness of mankind is easily understood if we survey the recent history of science and its social effects on our civilisation Europe, for example, has made much use of science and is being increasingly affected by the pursuit and application of science Yet Europe is neither happy nor peaceful It is in a pretty big mess with regard to its economic and social affairs As a consequence, some people have gone so far as to blame science for all our ills and to call it the evil genius of today. They will greatly welcome a long holiday for scientific research This however, is too simple an explanation to carry any weight and is based entirely on false grounds As Huxley once said it is wrong to ascribe moral values to science just as it would be wrong to call a hammer cruel if it is used for smashing someone's skull Science is essentially a tool and the results of of its application depend entirely on the motives of men who wield it It can be used for good purpose as well as for just the opposite ends, and if the modern civilisation, inspite of its scientific basis, is in an un happy state, it is because science is not functioning in a balanced manner

The lop sided growth of science results from the fact that the scientist can work only if he is suitably paid and given the necessary facilities by way of labora tory equipment and research grants The amount of money spent on the different branches of science determines their respective development During the last 100 years scientific research has become more and more dependent on industry and defence departments on account of the profit motive in the first case and survival incentive in the other This has resulted in a great development of the sciences of Physics and Chemistry, which underlie industrial and defence research, and culminated recently in the manufature of the atomic bomb We have got now almost whatever an average man could have wished from physico chemical research,—flying in the air, fast transport, rapid communication, television and so on Biological and social sciences, on the other hand, on account of the lack of financial support have been left far behind and are in a primitive condition We have been able to obtain only a partial control over our domestic animals and crop plants, and we know almost nothing about human nature, while actually it is in these fields that knowledge and some sort of understanding is most urgently needed if the world is to be brought into some kind of orderly state

It is a happy sign of the times that this malfunction of science, its frequent diversion into wrong channels,

* Part of the Presidential Address delivered before the Twenty-eighth Annual Meeting of the Indian Botanical Society held at Allahabad on January 2, 1949. For full report see *Jour. Ind. Bot. Soc.*, *28*, No 1, 1949.

its misapplication and unbalanced development are beginning to be realised in Europe and America

If India has not seen much of the ill effects of science, it is because we have had so far very little of science But now that we propose to cultivate it on a big scale and harness it for the development of the country, the mistakes made in the West should be avoided If science is to act as the growing point of our advance, it should be seen that the growing point functions in a properly balanced manner Otherwise, the growth to which it will give rise,—and this will be the future of this country,—will certainly be unhealthy and a malformation Unfortunately this aspect of science has been hardly considered so far by the authorities who guide the scientific policy of our country

Reviewing the progress of science in India on the occasion of the first anniversary of Indian Independence (August 15, 1948), Sir Shanti Swarup Bhatnagar, Director of Scientific and Industrial Research and Secretary, Department of Scientific Research, Government of India, mentioned the establishment of about a dozen national research laboratories for the investigation of problems of a fundamental as well as applied nature He also announced the setting up of a Board of Research in Atomic Energy to ensure proper utilisation of India's resources of atomic energy and to collect up to date information on developments in this field, establishment of Committees and Commissions for the nanufacture of synthetic petrol and such other things, but there was hardly any mention of biological research The impression is given that the science of plant and animal life are hardly of any value except perhaps as subsidiaries to agriculture, forestry or medicine This is astonishing when many of the fundamental problems facing the country, such as over-population, strong caste and communal prejudices, conservation of soil and increasing its fertility, feeding the hungry millions, raising the standard of their health and physical and social well being, all require a biological approach

The short-sightedness of the present policy can be further realised also from a few other simple facts One of these is the limited nature of the mineral resources of every country Sooner or later a day will come when these will be completely exhausted, for they have not the capacity to recreate themselves The green herb and the tree alone can continue to meet for all times to come the needs of mankind, for they alone can reproduce their kind The greatest single discovery of the future, which may transform the entire face of the earth, perhaps will be the artificial synthesis of carbohydrates from carbon dioxide and water Knowledge of the physiology of the desert plants, drought resistance, etc, is essential if ever our dreams of conquering the desert and turning waste lands into smiling fields are to materialise Yet we are doing hardly anything to cultivate research in Plant Physiology or Plant Bio chemistry We have not made any serious efforts to advance research in the field of Ecology either, which could be of great help not only to Agriculture, Forestry, Fisheries and tackling the problems of soil conservation, but also provide us with the right approach to the solution of many of our own social problems Few seem to realise the value of Genetics We have not one professorship or even a readership in this subject in any of our universities Sometimes back when there was a discussion on some of our marriage laws in the Central Legislature not one member of that august assembly approached the question from the viewpoint of our present knowledge of heredity and variation The fact is that we have not more than one or two serious students of human heredity in the entire country

Need for National Biological Laboratories

It is generally agreed that support of such character is required for fundamental research as will give a well-proportioned development of all branches of natural knowledge Two years ago, the Botany Section of the Indian Science Congress passed a resolution asking for the establishment of a Central Institute of Plant Physiology Both the animal and plant ecologists have been demanding off and on for an institute to foster the study of Ecology We have often cried for a National Herbarium, some regional herbaria, at least one good botanic garden in each province, for a Bureau of Plant Introduction, and so on Yet all this has been so far a cry in the wilderness However, now that we have a separate Ministry of Scientific Research, let us hope that the authorities will give thought to this malfunctioning of science and see that the different departments of Biology are given their due place and are properly developed for the progress and happiness of the inhabitants of this vast country

One can see that it may not perhaps be possible for the government or the Council of Scientific and Industrial Research just now to meet the demand for all these separate institutes, but it should be quite possible to set up at least the National Biological Laboratories of the status of National Physical and Chemical Laboratories. These Laboratories should foster pure and applied research in all such biological subjects as are usually neglected at the universities or are not at present properly studied in the country They should have 8 to 10 divisions devoted roughly, so far as plant sciences are concerned, to the following subjects (1) Systematics, (2) Anatomy and Pharmacognosy, (3) Plant Physiology,* and Bio-Chemistry, (4) Ecology, (5) Micro-biology,* (6) Genetics and Cytology * There must be a division for the study of Human Genetics and Behaviour The divisions of Ecology and Genetics and Cytology should be common to Botany and Zoology, and

*Extension of facilities in these subjects are envisaged in the Report of the Vallarta Committee appointed by the Government of India in 1947 to report on the future expansion of the Bose Research Institute, Calcutta. Unfortunately, these recommendations involving increased recurring expenditure of the Institute by a sum of Rs.2 lakhs only is yet to be implemented by the Department of Scientific Research, Government of India. (Ed. *Sci. & Cul.*)

all the divisions must work in close co-operation so that we can have at least one place in the country where complex biological problems could be attacked from several directions *

Of the possible objections to the above scheme, two may be answered here It can, for instance, be said that research in genetics and plant physiology is the function of agricultural and forestry institutes and the government is already employing qualified persons for these subjects in such institutes It should, however, be obvious to everyone that the number of such workers is very small and they are so much preoccupied with the solution of immediate problems before them that they have hardly any time to think about pure and fundamental research

Secondly, some may point out that research in Systematics belongs to the province of Botanical and Zoological Surveys and there is no need for a Division of Systematics at the proposed National Biological Laboratories I hope you will permit me to say that Systematics is not only valuable in itself, but its study is most essential for the pursuit of research in the fields of anatomy, pharmacognosy, ecology, cytology and genetics It is only a botanist with wide knowledge of plants provided by training in Systematics who can correlate knowledge obtained from these different branches Hence a Division of Systematics at the proposed Laboratories is quite essential

INDIAN BOTANY TODAY

When we survey the present position of Indian Botany, we observe first of all the gradual development and establishment of a flourishing school of Palaeobotany at Lucknow †

We next see great progress in the study of the embryology of flowering plants, due to the efforts of exactly not any one particular individual but due to a large number of workers at several university centres taking to investigations in this field Valuable contributions have come even from teachers in small Intermediate Colleges, so that we can say that research in this field has been truly established in the country Our contributions are now of such nature, both in quantity and quality, that we are behind no other country. Three factors have been especially responsible to our taking to research in this subject (1) the great emphasis in our curricula on the study of the life histories; (2) the availability of a large number of plants needing investigation, and (3) the poor library facilities in our universities and colleges correlated with the timely appearance in the year 1931 of Schnarf's "Vergleichende Embryologie der Angiospermen," which provided an easily accessible clue to the previous literature on the subject Yet even in this field it is no time for us to rest on our oars Our investigations have been confined mainly to the development of the embryo sac and the male gametophyte Most of the investigations have been of the descriptive type and little attempt has been made to correlate embryological studies either with genetical research or taxonomy

We have also done considerable work on the anatomy of the vegetative parts of angiosperms, particularly on the anatomy of timber trees at Dehra Dun and on stems and roots with anomalous vascular construction There are also several papers dealing with the anatomy of xerophytes, halophytes, etc and in recent years some good contributions have been made to the anatomy and morphology of the flower In the field of Systematics of the Angiosperms it is disappointing to note a lack of interest in the universities in spite of the fact that in this field we inherited some very fine traditions from European botanists, who laid the foundations of Indian Botany in the 19th century and whose efforts had brought international fame to the Royal Botanic Gardens, Sibpur The policy of the Government has been largely responsible for the present static condition of the Sibpur Garden but in spite of this we have on our credit side the publication of several provincial and local floras and the development of the herbarium at Dehra Dun

In the field of algology we have several workers in the universities and very valuable contributions to our knowledge in this field have been done at Madras, Calcutta and elsewhere both by professional and amateur algologists In the fields of mycology and plant pathology we have a large number of workers and a fair amount of research is being carried out both at the universities and in the government agricultural departments We have, however, neglected the study of the morphology, life history and cytology of the Indian Fungi

The late Professor S R Kashyap did pioneer work on liverworts, but his investigations have not been suitably followed up, and now even his collections of Indian bryophyta, as also of Tibetan plants, have been left in Pakistan On pteridophyta and gymnosperms, our contributions have been chiefly towards their anatomy and morphology, but some monographs on the systematics and distribution have also been published

It is when we consider the departments of plant physiology, ecology, microbiology, cytology and genetics, which are now receiving so much attention abroad and constitute what can be aptly designated as modern botany, that we find our position most disappointing The distinguished researches of Sir Jagadish Chandra

* A plea for the establishment of a National Entomological Laboratory is also put forward by Dr H S Pruthi in his presidential address to the Entomological Society of India, a summary of which is printed elsewhere in this issue Ed *Sci & Cul*

†An Institute of Paleobotany sponsored by the Paleobotanical Society of India, is the only botanical institute under the purview of the Department of Scientific Research, Government of India and is recipient of capital and recurring grants from the Central Government. (See SCIENCE AND CULTURE, *14*, 241, 1948). The foundation stone of this institute, of which Prof. B Sahni is the founder-director, will be laid by the Hon'ble Pandit Jawaharlal Nehru on April 3, 1949. Ed, *Sci & Cul*.

Bose into the life processes of plants have not been followed up in spite of the existence of the Bose Research Institute * Some years ago we had hopes for the establishment of schools of research in plant physiology at Bombay and Banaras Hindu University, but these hopes did not materialise Our contributions to the sciences of ecology and microbiology, when we compare them to what is being done in Europe and America, are almost nil In cytology we have a large number of young men who have received training abroad and published very valuable papers, but many of them were not able to continue their work for lack of adequate facilities In genetics also, in spite of some good workers and plant breeders in the agricultural institutes, our fundamental contributions are comparatively small, and the subject has not been seriously studied in the universities except in a most superficial manner We have also done little work in the field of pharmacognosy, which is so essential if the drug resources of the country are to be properly utilised and when our indigenous systems of medicine are to be put on a scientific basis, and as recommended by the Chopra Committee

Urgent Need of Changes in Teaching and Syllabuses

The above brief review of the present status of Indian Botany brings out very clearly our backwardness in many directions, but I am hopeful that it can be overcome in a large measure by revising the method and the quality of our teaching

We have hardly ever given thought to the teaching of botany in this country Even the Indian Botanical Society has not once considered the subject seriously, and we have never attempted any organised research into the methods used Perhaps that is true of education in general What generally happens is that anyone who has taken the degree of Master of Science is considered good enough to teach He starts his career as a demonstrator in a university or as a lecturer in an Intermediate college and begins teaching in the manner in which his own teacher taught him some years ago The result has been that the syllabuses and curricula of our universities have remained static and are more than 25 years behind the present developments in the science

If we look into any recent number of *Biological Abstracts*, it will show that more than 75 per cent of the research in botany today is done in the fields of physiology, ecology, pathology, cytology and genetics In our curricula, however, we give the least importance to these subjects In the University of East Punjab, for example, there are five theoretical papers at the B Sc Honours School Examination One of these is devoted to writing an essay and is common to all departments of botany Of the remaining four papers, three are devoted to the morphology and classification of plants (of which two are confined to cryptogams and one to seed plants), and there is only one paper embracing all the fields of plant physiology, ecology, cytology, genetics and evolution! The emphasis on the different aspects of botany in the B Sc Pass Course is similar Of the two theoretical papers, one is devoted to the study of the cryptogams and the second embraces every other division of botany Conditions in other Indian universities are more or less similar and what is still worse is that it is very difficult to convince many teachers about the lop sidedness of the present syllabuses and the need of a change

It is not possible to go into more details here with regard to the syllabuses for the different examinations, but it is absolutely essential that these must be modified if we are to make an attempt to bring botanical research in our country to the level of the West and win for it a more honoured place in the counsels of the nation.

With the continuous rise in the population of the country, it can be taken for certain that food will be both scarce and dear for many years to come, and whatever may have been the policy of the government in the past or is at present, the government will be forced to revise its attitude and compelled to undertake agricultural research on a vast scale There will thus open out before us many opportunities for doing fundamental work in plant physiology, bio chemistry, micro biology, pathology, genetics, cytology, ecology and even systematics In order to provide a sufficient number of workers trained in these fields, the study of these subjects must be fostered at the universities If we are able to correlate botanical teaching and research at the universities with the needs of the agricultural science, forestry, botanical survey and pharmaceutics, we shall not only serve the country but also greatly stimulate botanical studies themselves

The first step that we need to take in this direction is to approach the elementary botanical teaching —this is Intermediate teaching in most of our universities— from a new angle In my opinion the most suitable method will be to teach from the standpoint of functional morphology We should adopt text books like Fritsch and Salisbury's "Plant Form and Function" or Sinnott's "Botany, Principles and Problems" as our models and not continue with books of the type of Lowson's "Text book" or Green's "Manual" Surely it will interest the students much more to know the working of the various organs of plants, to learn the laws of heredity and evolution and their application to the improvement of our economic plants, domestic animals and even our own social system, and to study plants in the field and observe their relations to one another, to other animals and to the physical characters of the environment, than to mug up a large number of difficult terms describing the forms of the stipules, margin or apex of the leaf etc In the B Sc. Pass, Honours and M.Sc. syllabuses, we must

*Prof Joshi is evidently not aware that Sir J C Bose's plant physiological investigations are being continued in the Bose Institute and some of these have already been published in the *Transactions of the Bose Research Institute*, 12 16, 1936–46, Ed. *Sci & Cul.*

make more room and give greater importance to physiology, ecology, genetics and related subjects and ask the university authorities to establish chairs or readerships for their teaching and provide ample funds for their development

Exchange of Staff between Universities and Government Departments

Another method of stimulating botanical research in the country and making it more balanced is to devise ways by which workers in the universities on the one hand and government departments on the other could be brought into close contact Inspite of the annual sessions of the Indian Science Congress and meeting of some learned societies, botanical research at the moment in the universities and agricultural and forestry institutes is widely separated If we are to work as a team for the common good of the country and the advancement of our science, a scheme must be worked out whereby it should become easy for teachers and scholars from universities and colleges to spend some time at the agricultural and other departments of the government, and similarly it should be made possible for workers in government departments to work for some time at the universities Such exchange of personnel would certainly have a very stimulating effect both on the individual workers as well as on the different branches of science Every institute has its own special laboratory practices, technique and methods, which are often of considerable interest and practical use to others if they could have the opportunity to familiarise themselves with them Working for short periods on special problems in agricultural or forestry institutes would also help university teachers and scholars,

"to lose the ivory tower outlook which many acquire when they remain in the academic fields too long It would also benefit their teaching since they would have a personal experience of the environment and types of problems which will face eventually many of their students when they take posts there There will also come an internal stimulus to the reform of curricula and syllabuses since actual experience will show to the academic worker, temporarily working elsewhere, the growing fronts of science "

Lag between Research and Teaching

Before closing the subject of botanical teaching, attention may be drawn to one other important matter This is the time lag between the acquisition of new knowledge and teaching In all countries there is some interval between the publication of results of scientific investigations and their incorporation into teaching, but in India such time lag is enormous. For example, it was many years back that the individuality and permanence of the chromosomes throughout the nuclear cycle was established Yet even today, almost all the text books commonly used by our students speak of the segmentation of the spireme to form the chromosomes. Even the description of conjugation in *Spirogyra*, which is a type for study in elementary classes in every university, is out-of-date. If we really desire to keep abreast of the recent advances in the subject and give our pupils the right knowledge, it is absolutely essential to remedy this drawback in our teaching The following measures are suggested to meet the situation

1 We should have text books by active research workers who are familiar with recent advances in the subject It is to be greatly regretted that persons with such qualifications have mostly avoided the writing of elementary text books. The result has been that our students have to use either English or American text books with illustrations of foreign plants or to depend at the best on second rate Indian books It is time that our learned colleagues realise this fact, discontinue to confine their learning to themselves and impart some of their reserves of information to the comparatively ill informed We have now a fair knowledge of the life histories of several Indian types It is time that this knowledge is incorporated into our teaching

2 There should be more reviews in our journals A good review should be given as much credit as an original paper

3 Steps should be taken to organise special vacation courses. Our universities and colleges have a long vacation during summer It is then very pleasant in the hills and it would be most beneficial to the progress of our science if we could organise a laboratory at a suitable hill station where teachers and research scholars from all parts of the country could gather during the summer holidays and enlighten each other on the recent advances in their respective fields

Need for a Standing Committee on Botanical Teaching

Finally, I venture to suggest that the time has come when we should consider the question of botanical teaching in right earnest The Indian Botanical Society should elect a Standing Committee to constantly look into it and give the right lead to the universities This should prove especially valuable now that the country is seriously considering to change the medium of instruction The committee should also take steps to organise research into the methods of botanical teaching

Systematic Botany

Paradoxical though it may seem, still it is true that in spite of great emphasis on the study of external morphology in the Intermediate classes, our students as well as a large majority of teachers show great ignorance about systematic botany and are quite unfamiliar even with the names of common plants of their neighbourhood As a friendly Englishman once put it, "In India people become botanists without knowing plants " In a large measure this is due to the lack of suitable district and local floras We should try to have a handbook of flowering plants at least for every university town as soon as possible, as we have a "Forest Flora" by Kanjilal for the use of the students of the Forest College, Dehra Dun, or "Lahore District Flora" by Kashyap and Joshi * These floras should

*We are also indebted to Mr A P Benthall (an amateur botanist and lately President, Bengal Chamber of Commerce, Calcutta) for his book entitled "Trees of Calcutta and its neighbourhood" (See SCIENCE AND CULTURE *12*, 445, 1947). Ed; *Sci. & Cul.*

not form big tomes, but should be of the type of pocket books which could be easily carried by the students. Most of the country floras in the United Kingdom have been written not by professional botanists but by amateurs. A similar attempt should be encouraged and supported by public and private authorities in this country. Teachers in *Muffasil* Colleges, who cannot undertake research work of any other kind, can do very useful work in this direction. Their former professors with whom they are generally in contact should suggest to them to take up this work. This will give us not only suitable handbooks for the use of the students, but also provide detailed information about the distribution of plants in our country.

Another thing which can stimulate interest in systematic botany amongst our students is the organisation of frequent field work. University, government and other college authorities should be made to realise that such surveys are a very important part of the training of students in botany and they should provide suitable grants for this purpose. Often the authorities have the impression that these surveys are only a holiday for the teachers. Attempt should be made to dispel such doubts. When botanical excursions are not seriously taken up by our teachers they do a disservice to our cause. We should try our best to see that the students gain as much knowledge as possible from field work. They should make extensive collections of plants and these collections must be identified in order to supplement and correct their purely bookish knowledge. In the case of the M Sc students, one trip to the Himalayas or some other mountain and one trip to the seashore should be considered essential before they pass out. In the case of the undergraduate students excursions to fields, neighbouring strips of semi-wild vegetation, gardens, hedges etc, may be considered sufficient, and these should not be neglected. The B Sc Pass, Honours and M Sc students should be asked to produce identified and labelled collections of plants at the time of their examination. Such collections should not be thrown away after the examination but added to the college or a local herbarium, and students made to realise that they are thus making a useful contribution to the advance of Indian Botany.*

A great impediment in the advancement of systematic botany in the country is the absence of botanical gardens. It is wrong to believe that one botanical garden at Calcutta, however big it may be, would serve the needs of the country. We need a botanical garden for every province and State and for every large city, for the education not only of the students of botany but of the general public as well. It will serve besides the professional botanists, also the school children and their teachers, horticulturists and horticultural amateurs, owners of large and small gardens as well as their *malis*, commercial and semi-commercial growers and amateur naturalists.

For the development of Systematic Botany at the higher level our foremost need is an up to date central herbarium, which many of us have preferred to call "The National Herbarium". For obvious reasons the herbarium of the Royal Botanic Garden, Calcutta, has got to be recognized as the "National Herbarium", but it is also equally true that it must be shifted to a dry locality if we are not to play with the future of Indian Botany. The herbarium at Calcutta suffers not only from the ill effects of the hot and humid climate of Southern Bengal but also from its situation on the bank of Hooghly. Dr D Chatterjee, who has now been working for some three years at Kew and had recently the opportunity to visit also several other European herbaria, informs me that while many of the specimens at Calcutta are crumbling into pieces, their duplicates abroad are quite fresh and show no effect of age. In my opinion an air conditioned building at Allahabad or Lucknow would perhaps be the most suitable place to house the 'National Herbarium'.*

In addition to the National Herbarium, we must have soon a number of regional herbaria. Such herbaria will not only greatly help in the rapid exploration of the vegetation and flora of their respective regions, but will also provide a prompt service for the identification of common species and save the time of the taxonomists at the National Herbarium from routine determinations. Only little known species or such specimens as require critical examination will be forwarded to the National Herbarium.

Finally, we have yet to maintain suitable liaison with foreign herbaria. Our government maintains an Assistant for India at Kew. The post, however, is very inadequately paid, so that ordinarily it will not be possible to have a suitably qualified person for the job. The Assistant for India at Kew is to be our final authority in most cases when we need a critical identification and he could be very useful to the development of the National Herbarium. Hence he must be a botanist of considerable experience. It is very desirable that a senior officer of the Botanical Survey or Forest Research Institute or some other Herbarium or Professor from a University should be

*This is actually done in some universities and at least in one, of which we know of *viz*, Calcutta University, where the Indian collections of the Herbarium are largely based on the collections made by the students and teachers inspite of limited financial and other resources. Ed; *Sci. & Cul.*

*We fail to understand why an air-conditioned building cannot be built in Calcutta to house the Sibpur Herbarium. We know on good authority the difficulties that are faced by the National Archives of India, in preserving books, manuscripts, etc owing to the extreme and nature of the climate of Delhi and the same troubles have also to be faced at Allahabad and Lucknow. An air conditioned Herbarium in West Bengal with an equable climate will be more desirable than one in the U. P region. What the Sibpur Herbarium is suffering from is not a climatic factor but a growing Herbarium with limited accommodation and meagre staff maintained by a Provincial Government for the benefit of the whole of India. The history of the Botanical Survey of India is unfortunate and we discussed *in extenso* the subject in an earlier issue (See SCIENCE AND CULTURE, *11*, 105, 1945). Ed; *Sci. & Cul.*

deputed for this work, and the government should arrange to pay him adequately *

During the last 50 years our country had to face financial crises from time to time This often led to retrenchment in the research departments The Botanical Survey and Systematic Botany have especially suffered in this manner † It is time that our society gives serious attention to this matter and I suggest that we should set up immediately a Standing Committee to constantly look into this question, and take necessary steps to safeguard the interests of Systematic Botany, and devise ways and means to promote its cause

*We would draw the attention of our readers to the circumstances that led to the creation of the Kew post and subsequently the post being given to an Indian (See SCIENCE AND CULTURE, *11*, 134, 1945), with a view more to learn the methods of Herbarium technique at Kew and its subsequent utilization in India. When a preliminary training has now been made available in India, Prof Joshi's suggestion may be carefully considered by the Government of India We would further urge the Government for the creation of a similar post in the British Museum (Natural History), for the benefit of Systematic studies in Indian Zoology, where most of the type collections of Zoological specimens from India are housed Ed *Sci & Cul*

†We learn to our much regret that one of the first items of post war reconstruction plans to be axed by the Standing Finance Committee of the Government of India unfortunately is the Botanical Survey A large number of Post Graduate students were trained to be absorbed as Botanists in this Survey and they have now to seek jobs elsewhere resulting to a waste of scientific man power trained by a National Government! Ed *Sci & Cul*

THE ADVANCEMENT OF LEARNING

DO the universities always advance learning, do the scientific societies always encourage research? These are questions yet to be answered Conflicting thoughts often brew in our mind and very few are bold enough to speak them out Dr Darlington is one of those outspoken few He has put in his inimitable straight language what most of us have felt in this country, regarding the universities and research institutions He says, "that men, and the societies and institutions they set up, are all inclined to resist scientific discovery and its application We resist them not so much for the material loss, as for the mental disturbance we fear from them As we get older, some of us acquire wealth, all of us acquire belief And between belief and discovery, there is an undying war "*

It is well known that classical discoveries of Galileo or of Harvey were obstructed and neglected Mendel was twice, on examination, refused his teacher's certificate These are not accidents, for "belief becomes more necessary and more sacred as one gets older The apartments of the mind are fully furnished, and there is no longer room to change about "

No one can answer, who are actually best suited for research Those who know everything by heart may win most of the academic prizes and may make their way into high administrative office But they never make discoveries And they do not much like other people to do so It is important to see that the first class honours man is not given a monopoly of scientific research Dr Darlington cites several examples where early research papers of contributors like Dalton or Joule had been rejected by the Royal Society A few years ago a young man offered to the Royal Society a paper showing the revolutionary consequences of applying new mathematical treatments to biological problems The two referees rejected it, one because it contained biology and the other because it contained mathematics The same paper was eventually published in the Royal Society of Edinburgh, where the author, of course, from his friends' subscriptions had to pay for the printing charges and the paper proved to be one of the epoch making works of the century Supposing the money had not been found, the rejection would then have meant suppression, as it was intended to Our young research workers usually face such difficulties when they begin researches in their own capacity How often we have seen dejection in their face when their papers have been rejected, often indiscriminately by the referees of the scientific societies, more often when known scientists, or heads of the institutions are not communicating the papers Once a Departmental Head forwarded very reluctantly a thesis for Doctor's Degree on the candidate's insistence, for he said that the thesis contained too many pages of botanical work and less chemical work, besides he thought the thesis would be judged only on the chemical portion, for the candidate graduated in chemistry! The candidate risked it, and all his three examiners spoke very highly of the thesis and recommended it The Head of the Department is not to be blamed for he knows so much "more and more of less and less," that he can no longer take in new things The papers which are rejected, often find good places in foreign journals and we know of cases where such papers have got good recognition.

*The Dead hand on Discovery—I & II, *Discovery*, *9*, 358, 1948, *10*, 7, 1949
I. The Fingers of Learning
II. The Thumb of Office by C. D. Darlington, D.Sc., F.R.S.

Dr Darlington writes of the same experience in England, for "sheltered by annonymity, referees can write with great freedom One paper was rejected by a referee of the Royal Society on the ground that too much had already been published on this subject, where in fact nothing had been published in England on the subject for fifteen years During that time all such papers had been rejected—presumably by the same referee since it was *his* subject"

There are three steps by which knowledge is resisted in the universities The subject is kept out of the curriculum as being debatable, abstruse and premature Even when included in the curriculum, it can be left out of examinations This is the subtle way of making the classes of young lecturers less important from the examination point of view, and growing minds have thus been stifled on several occasions Thirdly, anyone specialising in a new subject can be kept out of a university chair Scientific research arises out of the teaching in the universities If it is routine research it arises in loyal discipline If it is fundamental it arises by outrageous rebellion "Professors are free to inquire But men who inquire about new things are not free to become professors"

So far about the universities And, how about the Ministries Dr Darlington states that "scientists, it is admitted, possess the skill, and the knowledge, if not the wisdom, on which our (British) Government largely depends Ministers, therefore, sometimes feel that they must take scientific advice But the scope and possibilities of scientific method and discovery are unknown to them They naturally shrink from contact with the unknown or they resist its intrusion"

Every sentence of Dr Darlington reminds us of the condition of the Ministries in our country For our universities and Ministries are but imitations of those of England Dr Darlington then goes on to explain the formation of the Scientific Advisory Committee in England "The Minister, who is usually a non science man, appoints twenty men Rather his advisers do They begin by appointing themselves —half a dozen of them—to provide sound non scientific foundation Then they add half a dozen men who have had a scientific training long ago, but have now been made tame and tractable by an unblemished life time in the Civil Service And, finally they make up the number to a round score with administrative scientists, eminent men, who have, however, for a good while been prevented by just such committees from engaging in scientific research"

Are we not stepping into the wrong shoes of our past rulers? The Civil Service in our country has still the rusty frame with a good brushing of new gained liberty The Director of Industries in our Province is usually a Civil Servant, obviously a non science man or one who was a science student two decades ago As it is in Britain, so it is here The higher Civil Service is a self propagating organism Each generation chooses its own successors And, since like begets like, it chooses successors who shall be deeply imbued with a traditional and anti scientific attitude

A research problem is unfortunately classified by its effects It is bound to be superficial and defensive if the problem is classified by its effects To be fundamental and aggressive, investigations must be classified by causes The great advances in the technique of war have not come from specialists trying to improve current techniques, but from outsiders introducing methods which surprise the specialist, just as they in turn surprise the enemy Gunpowder was not invented by an archer or by an arrow smith

Since 1945, new scales had been accepted for research workers in Britain "The principle was of course maintained that the man without any knowledge of science must always be paid more than the man with some knowledge" Scientific workers in Government employment thus find themselves in a poor deteriorating economic position "Yet it is on this background that our (British) Government policy is based, under non scientific control, more numbers are a great asset and a source of prestige, since numbers, degrees and titles are all that a non-scientific administrator can possibly understand But it is the quality that counts in scientific research and never the quantity For what is not good is bad, and what is bad is a costly and dangerous liability" and the so-called selective awards to political sufferers, former congress workers, scheduled castes, depressed classes, minorities, and even provincial awards are definitely detrimental to the progress of our country and that it has been so, is seen by the inefficiency from which the working machinery of the country is suffering A hundred years' neglect has led to hundred years' decay And it cannot be made good in a year and a half of freedom!

R G C

POWER DEVELOPMENT WITH NUCLEAR ENERGY

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Introduction

An Atom Bomb exploding on the 26th July 1945 in a desert in Mexico and the horrible tragedy of Hiroshima on the 6th August of the same year focussed the attention of the world on Atomic Physics The release of nuclear energy for the destruction of humanity startled the world and started it thinking, could not the same energy be applied for peaceful purposes, applied constructively in industrial fields ! Considerable amount of speculation exists, and far and varied scientific and technical difficulties have to be solved before nuclear energy is finally established in the field of industrial application

The present paper deals in brief with development so far made in its application for power development, concluding with a rough approximation of the cost of power with a short reference whether it will be economical to develop power through nuclear energy as compared to the cost of the existing power systems, Thermal and Hydro The information here presented is from material hitherto made known The power costs have been approximated (these being estimated in America) on various assumptions which have to undergo considerable modifications as gradually developments take place and various datas built up

The paper is sub-divided as follows

1) Theoretical consideration of Nuclear Process involved
2) Thermal equivalent of Nuclear Energy
3) Availability of Nuclear fuel
4) (a) Schematic diagram of the proposed nuclear plant
   (b) Description of each component part
5) Design problems
6) Capital and Power Generation Cost
7) Advantages of Nuclear Power over the existing ones
8) Advancement to date

Theoretical Considerations of Nuclear Process Involved

An atom, according to Bohr's idea, consists of a nucleus, of +ve charge, in which practically the entire mass of the atom resides, surrounded by one or more —ve electrons, moving in elliptical orbits around it Except in the case of hydrogen, the lightest element known and the lowest element in the periodic table, the nucleus is built up of +vely charged particles called protons identical with the nucleus of the hydrogen atom and electrically neutral neutrons of practically the same mass as proton In case of most of the elements, atoms are found containing different numbers of neutrons and therefore of different atomic weights Except for this difference in the weights of atoms the other properties remain almost identical These varieties of the same element first discovered by F W, Aston in 1919 are termed Isotopes Natural uranium is made up of 3 isotopes, about 99 3% of U238 (Uranium) with an atomic weight of 238, about 0 7% of U235 and 0 008% of U234 which can be neglected

When most elements are bombarded by neutrons, the capture of a neutron by its atoms gives rise to new isotopes of that element, but when U235 is bombarded by neutrons something more results With the capture of the neutron by the atom the nucleus explodes violently breaking into two approximately equal fragments with the release of fresh neutrons amounting roughly between 1 3 With this breaking up of the nucleus, or nuclear fission as it is styled, the fission fragments are thrown apart with very high velocity The kinetic energy is converted into heat energy within a very short distance of the site of fission Both the fission process and radioactive decay of the fission products are accompanied by the emission of very powerful gamma radiations which are also transformed into heat rather further away The process of fission as shown by Hann and later on confirmed by Frisch and Meitner is as follows

$$\underset{92}{\mathrm{U235}} + \mathrm{n}\,{}^{1}_{0} \rightarrow \underset{92}{\mathrm{U236}} \rightarrow \mathrm{Ba}\,\underset{56}{139} + \mathrm{Kr}\,\underset{36}{97}$$

Fig 1

TABLE 1
FISSION PRODUCTS

Mass Numbers 83 115		Mass Numbers 127 154
Yttrium Zirconium	More	Cesium Barium
Columbium	abundant	Lanthanum
Molybdenum	fragments	Cerium
*Masutium Ruthenium		Paraseodymium Neodymium

*Name not definitely assigned

How is this energy derived ?

The weight of uranium before fission, and weights of fragments after fission indicates loss in mass during nuclear reaction This lost mass replenishes itself in the form of energy, its energy equivalent being

$E=mc^2$, where E=Energy, m=Mass which has been converted into energy, c=Velocity of light (3×10^{10} cm)

Though a very insignificant fraction of the total nuclear mass gets converted into energy by the present process, still its energy equivalent is enormous If a method can be found which will convert entire mass into energy, then the energy released can be increased by a tremendous factor.

Thermal Equivalent of Nuclear Energy

Nuclear fission is accompanied by a release of huge quantities of energy An attempt is made to interpret this in terms of thermal energy Heat available from coal is measured in terms of B Th Units whereas in nuclear reactions it is measured in electron volts/atom

The energy released by the burning of coal to give carbon dioxide is of the order of 4 e v /atom In the nuclear reaction uranium releases 200 million e v /atom

1 lb of uranium contains 11760×10^{20} atoms, the energy released by 1 lb of uranium 235 when fissioned
$=(11760 \times 10^{20} \times 200)$ Mev

1 lb of coal contains 230×10^{23} atoms, and the energy given off per lb of coal burnt
$=(230 \times 10^{23} \times 4)\text{ev}=(920 \times 10^{17}$) Mev

From the above comparison it will be seen that the energy released by 1 lb of uranium roughly approximates to 1500 tons of coal What magnificent source of energy each atom of uranium has!

Availability of Nuclear Fuel

At present it is thought that the quantities of uranium are not very abundant, and the question one has to face is whether it will be practical to install plants with the known stock of world resources of fissile materials? Uranium which could be found from earth's crust is large, but whether this is all available or will be available is a problem In most countries survey in search of uranium has started with great vigour Information and datas collected from this when published might give us a correct idea of the availability of nuclear fuels Information available before 1941 indicated that the then "commercial deposits" of uranium contained 10^8 lbs of metal, where commercial deposits have been defined as deposits which contained ores of uranium concentration greater than 1% Goldschmidt suggested that about 4 part per million of the earth's crust is uranium If one third of the earth's area 6×10^7 sq miles is estimated to be available then 4 parts per million represents a total of about 10^{16} lbs of uranium in a 3 mile deep layer, thus total available quantity of uranium would work out somewhere between 10^8 to 10^{16} lbs

These deposits are situated mainly in Belgian Congo, at copper mines in Haut Katanga, in Canada, at the Great Bear Lake, and in the United States, in Colorado and Utah in Joachimstal deposit extending to Saxony of Russia Of these deposits only 7% of the total uranium is U235 !

Recent advances in the knowledge of atomic physics brings into light some encouraging information about the sources of nuclear fuel Apart from uranium, Nucleonists say, there are materials which are not themselves fissile but when undergo certain nuclear reactions yield fissile elements

One of them is U238 When a U238 nucleus is bombarded by a neutron, its capture results in U239, a very unstable isotope, which undergoes radioactive

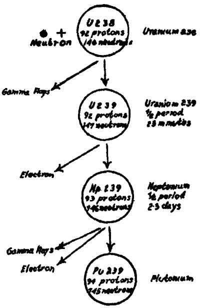

FIG 2 – Synthesis Of Plutonium

decay in two stages in each of which a neutron in the nucleus is transformed into a proton and electron, the latter is ejected from the nucleus The final product, plutonium as it is called, has 94 protons in its nucleus as against 92 in uranium This nucleus possesses the property of undergoing fission when it captures a neutron like U235 (Fig 2).

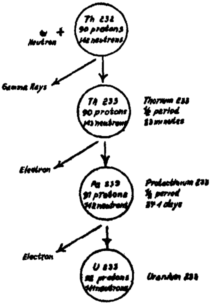

Fig 3 – Synthesis Of U233

The other is thorium It has an atomic weight of 232, and has 90 protons in its nucleus as against 92 in uranium It is also not fissile by itself But when it captures a neutron, after two stages of radioactive decay with the conversion of two neutrons in the nucleus to protons, it becomes U233 with 92 protons, in fact an isotope of uranium This new isotope undergoes fission when it captures a neutron (Fig 3)

It is estimated that the concentration of thorium in the earth's crust is about 11 5 part per million taken for the same part as considered before so that roughly 10^{16}--10^{17} lbs of thorium is available Mineral monazite containing thorium are found in the State of Travancore, and round about the northern part of Madras Province near Vizagapatam in India, in Brazil, in Carolina and Virginia districts of United States, and in Madagascar

SCHEMATIC DIAGRAM OF NUCLEAR PLANT

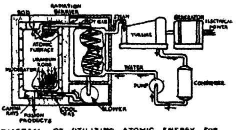

FIG 4 — DIAGRAM OF UTILIZING ATOMIC ENERGY FOR INDUSTRIAL POWER (U S A)

There is no method yet discovered which directly converts nuclear energy into electrical energy and the nuclear energy can only be indirectly utilised for power purposes in the form of heat There is thus no difference in heat transfer between the present system using heat from coal furnace to that of heat from nuclear fission

For conversion of nuclear energy into heat first, and then utilise it for the raising of steam for the running of turbines, the set up consists of

(a) an atomic pile where nuclear reactions take place and heat is thrown out,
(b) a heat transfer medium associated with pumps for circulation ,
and (c) radiation barrier, which is extra in comparison to the steam plant

Atomic Pile When a lump of uranium metal containing uranium 235 atom is bombarded with a neutron, nuclear fission sets in and 1 3 fresh neutrons are ejected, (i) in this process these neutrons might escape and can be lost which is quite probable since its velocity is nearly 50 million miles/hour , (ii) the neutrons may be captured by U238 nuclei, or (iii) they may be captured by U235

Since the amount of U235 in natural uranium is very low, as low as 0 7%, the probability of neutron capture by U235 is very low For a continuous reaction, or chain reaction, at least one of these neutrons must be captured by U235 Hence for chain reaction , either (i) the proportion of fissile material in natural uranium must be increased, or, (ii) some means must be adopted to increase the neutron capture capacity of U235 such that the numerical disproportionality is neutralised

The isotope separation to increase the proportion of fissile material in natural uranium is essentially done in two ways

The electromagnetic separation process This process contains a large number of machines called calutrons each of which is capable of producing U235 The calutron is a modified and a large mass spectograph Uranium is ionized, *i e* , broken down into electrically charged molecules and the ions are shot at high speed past a very powerful magnet which deflects them The degree of deflection is determined by e/m The U235 ions are deflected more than the slightly heavier U238 ions, so that finally they come out at a different place, and hence can be collected separately This method is extremely delicate and requires careful handling, besides, the individual machine has a very low output, power consumption is very high, and the man power required to produce one lb of material is all out of proportion with other alternative methods

The thermal diffusion process In this process uranium combined with flourine to form a gas is forced through stage after stage of sieves, barrier membranes—numerous stages in which a permanent temperature gradient is maintained The light isotope U235—the fissionable one—goes through sieves a little more easily than the heavier U238, so what emerges at the far end is enriched in U235 This plant is simpler in construction and operation but requires a huge amount of thermal energy Though the labour required here is less, it is not a very efficient method and the separation has to be effected in many stages

Both the above methods have been abandoned as they do not only involve complicated systems but are also uneconomic

Another method The neutrons given out in fission are very fast, speed corresponding to several million electron-volts of kinetic energy U238 nuclei have in fact a very strong affinity for neutrons of such high speeds which is detrimental to chain reaction But if these neutrons can be slowed down quickly to thermal velocities near about 5000 miles/hour then not only the chance of neutron capture by U238 is greatly reduced, but the probability of neutron capture by U235 is greatly increased since U235 has got strong affinity for neutrons of certain extremely low energies Hence if uranium is arranged in a lattice of small lumps, many of the high speed neutrons will diffuse out of the uranium into some surrounding material and many of them would be slowed down by collisions with the nuclei of the surrounding material thus making capture of neutron by U238 unlikely

The material which is used for slowing down neutrons and itself does not absorb them is the moderator.

According to the theory of elastic collisions, the ideal substance to be used for the moderator is one of the same mass as a neutron in fact a portion, i e, a hydrogen nucleus, but its strong affinity for hydrogen makes its use impossible Deuterium or heavy hydrogen can be used, but carbon in the form of graphite stands a better chance from economic point of view, and also it is satisfactory so far as its neutron capture point is concerned

In America large piles with graphite blocks are built with uranium metal in the form of rods, spaced out within, so that the neutrons from each rod of uranium traverse enough graphite before they enter the next rod of uranium or return to the one which they had left Successive collisions with graphite nuclei bring down the velocity of neutrons sufficiently low and well within the thermal region of energies The function of moderator could be understood from the figure given below

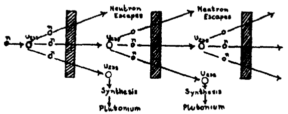

FIG 5 - Function Of A Moderator

The critical size of the Pile and the Multiplication Constant Suppose the first fission produces 'n' number of neutrons Theoretically, they should undergo about 200 collisions, to reach the speed region of thermal energies, but while undergoing collision, some will be absorbed by the structural materials of the pile, and some will react with U238 Say, x number of neutrons are finally left available for producing fission Each of these neutrons in turn will produce x^2 These will again produce x^3 which will in turn produce x^4 and the series will thus continue, so the one primary neutron produces $1+x+x^2+x^3+$ neutrons,

$$\text{and this is} = \frac{1}{1-x} \quad \text{when } x < 1$$

$$\text{and} = \frac{x^n-1}{x-1} \quad \text{when } x > 1$$

Thus as x approaches unity one neutron will produce a chain of very many more, but the chain is convergent

If $x > 1$, the series is divergent and one neutron will produce an infinite number of neutrons in a pile of very large size If the pile is small many neutrons will escape before producing fission Hence a pile has a critical size before chain reaction can develop

If M = migration length or the distance travelled by neutrons between birth and death,

and a = length of the pile

then it can be shown that critical value of 'a' is $= \frac{M}{\sqrt{x-1}}$

At the critical size the proportion of neutrons escaping is such that the effective x is

$$x_{\text{eff}} = x - x_{\text{leakage}} = 1$$

For this particular size, the pile is then in equilibrium and the neutron density will remain constant

Control of the Pile If a pile is so arranged that more than one fission results from the neutrons produced by each fission, there will be rapid neutron multiplication If the multiplication is very rapid, heat generated will rise with explosive violence, this phenomenon becomes an atomic bomb Even if the reaction is slow, the pile would soon melt away if the multiplication is uncontrolled

However, another fundamental nuclear phenomenon makes this control easier, the production of delayed neutrons It was discovered in May 1941, that most, not all, neutrons come out instantaneously in fission process The atomic fragments which are thrown away in highly unstable conditions throw out an additional number of neutrons after a short delay, say, amounting on the average to half a minute This time lag in multiplication provides the system with a very desirable inertia thereby making the control easy

One way to control this multiplication of neutrons is by providing passage ways in the pile through which rods of material which strongly absorb neutrons are moved freely, so that when these control rods are well within the Nuclear reactor, they absorb so many neutrons that the chain reaction is stopped As they are gradually withdrawn, a point is reached at which the reaction can just proceed If it is pulled out further, the power level of the pile will increase exponentially, but will take a long period, some minutes, before the final level is reached Having raised the power level to its new value, the control rods are wound back and thus the power level is finally established By this method the power level can be adjusted very nearly to the desired value For these control rods cadmium and boron containing steel have been suggested

There are also certain other inherent difficulties associated with a nuclear reactor which require careful consideration

Since, greater part of the energy released in the reactor is in the form of heat, any attempt to get an output more than a few KW leads to dangerous overheating, a cooling agent is hence to be circulated through the channels running through the reactor But, all the extra interior apparatus increases the neutron absorbing material unproductively which may gradually choke the whole system ultimately closing down the reaction itself, so that large scale power producing atomic pile will involve much more complicacy in design than an experimental pile producing only a few KW or so,

Again, uranium is very reactive, chemically combines rapidly with oxygen, nitrogen and hydrogen below 300°C, also with carbon and is readily attacked by water The fission products are also extremely radioactive Uranium rods, therefore, must be enclosed in an absolutely gas tight sheath to protect them from corrosion and to retain the fission products This sheath must of necessity be a good conductor of heat, and make perfect thermal contact over the whole surface of the rod If the heat transfer media is water, stainless steel or cupro nickel may be suggested as good corrosion-proof sheets, but since their neutron capturing capacity is too high choice is only left to beryllium and aluminium Beryllium in ductile form is very difficult to get and the final choice is led to aluminium for the sheath

In order to keep down the amount of neutron absorbing material in the pile to a minimum, it is necessary that the sheaths and tubes should be as thin as possible and the annulus through which the coolant will flow as narrow as possible To produce power, with any reasonable degree of thermal efficiency, if water is used as coolant medium it must be maintained under considerable pressure with the result that the aluminium sheath must also be made thicker This extra weight of, slightly but still definitely, neutron capturing material will upset the balance leading to complete shut down to the chain reaction itself Also water forms films on the surface of the aluminium interfering with the heat transfer and thereby produces serious corrosion and pitting Water, therefore, seems very unlikely as a medium of heat transfer Some suitable gas has to be found which will satisfy all the above requirements Helium is one of the gases but its heat capacity is low Bismuth can be used, since it has not only got a very low neutron capture cross section but also the heat transfer both from the rods in the pile and to the tubes in a boiler is high

Of the two moderators which are in use

(i) *An Atomic Pile where graphite is used as a moderator* Its essential components are,

(a) large mass of moderator filling large proportion of the total volume of the apparatus, here this being graphite,

(b) space in the interior of the graphite mass filled with uranium rods so that it is easy to take them out when necessary to submit them to chemical treatment,

(c) interior walls of the graphite for the circulation of coolant, (if the fluid is gas then no separate wall is necessary, but for water cooling an additional wall to that formed by the graphite surface is necessary Tubes of aluminium are consequently inserted and water is circulated between the protective sheath enclosing the uranium, and the tubes prevent the water making contact with the graphite),

(d) control rods within the pile in spaces specially designed for easy adjustments, and

(e) similar spaces for measuring instruments, automatic control sensitive to temperature, and radiation, and any other experimental apparatus

When thorium is exposed to neutrons it gets converted into U233, a fissile material To prepare U233 thorium, or a suitable salt of it, it is placed in the outer layers of a graphite-uranium pile, so that it is exposed to neutrons which would otherwise escape As the amount of fissile element in the pile is increased, more and more thorium can be inserted into the system without disturbing the inside balanced chain reaction But unless graphite uranium pile can be worked such that the amount of plutonium yield is at least equal to the amount of U235 burnt up, the use of thorium for getting U233 will lead to no real gain Admittedly, some thorium will be converted into U233 but an equivalent amount of U238 will be left as an inert useless substance

In order to separate U233 from thorium, or plutonium from U238 the products have to be sent through a chemical separation plant The idea of enriching the fissile material in the atomic pile by separating U235 from U238 was discarded U235 and U238 are identical in chemical properties except that their atomic weights are different Any separation method has to depend on this very small difference between their atomic weights In the case of thorium, U233 being chemically different from thorium, it can be separated by fairly simple chemical methods, the same also applies in respect of plutonium

There is also another suggestion When U233 undergoes fission the number of neutrons ejected, considered with the neutrons capture cross section, may make it possible to build a pile containing U233 and thorium in which more nuclei of U233 are formed than are burnt up, so that the supply of U233 is continually increased If this turns out to be practicable, then having once made a quantity of U233 from thorium placed in a uranium pile, U235 can be totally dispensed with, by making use of thorium as the raw material This process, which is still a hypothetical one, is called "breeding" For this process $x>1$, and if this becomes practicable, it will enable us to go back and burn up, by conversion to plutonium, any U238 which might have been dumped, as useless material from graphite-uranium piles, where neutrons available for conversion of U238 to plutonium is comparatively very much low

(ii) *Piles where Heavy Water is used as a Moderator*

Since the separation of the isotope (heavy water from water) involves a very complicated and costly process it is unlikely that heavy-water piles will be an economic proposition in the sphere of power production However, its essential components are similar to that of graphite piles, if allowances are made for the fact that the moderator here is liquid The use of heavy

water in place of graphite results in far more favourable balance between production and absorption of neutrons

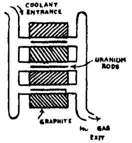

FIG 6(a) LAY OUT OF A GRAPHITE PILE

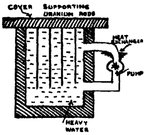

FIG 6(b) LAY OUT OF A HEAVY WATER PILE

This brings down the critical size of the reacting mass resulting in an increase in neutron density at a given power This, therefore, is of more scientific than industrial importance

Radiation Barriers Since fission products are intensely radioactive, and enormous number of neutrons are escaping from the pile, it has to be shielded properly for the safeguarding of operators Steel plates and a thick layer of concrete have been suggested To quote an example, a pile generating 100,000 KW will burn up 0 2205 lbs or 100 gms of U235 per day It will destroy thereby 3×10^{18} atoms per second, *i e*, at least 3×10^{18} gamma ray quanta are being emitted with 6×10^{18} fission product atoms born These are all highly radioactive

One foot of concrete reduces the intensity of neutrons and gamma rays by a factor of 10 Since, 1 watt power level requires 1 ft of concrete, 10^{8} watts power level will require 9 ft of concrete

[*To be concluded*]

CONSERVATION OF COAL

S MUKHERJEE

ASANSOL, WEST BENGAL

IT is almost universally known, though perhaps not so widely appreciated in our country, that the industrial and, to a certain extent, the economic prosperity of a country in modern times depend in a large degree, on its capability of utilising its coal resources to the fullest extent Coal, and its economic use, is so important in the life of a modern nation that it almost forms a gauge of the degree of industrial development of the nation The uses of coal and its by products are so many and so consequential,— in steam raising and power generation, in locomotives and marine engines, in metallurgy and chemical industry, in mills and factories, etc ,—that its abundance or otherwise conduces largely to the greatness or poverty of the economic condition of a country

It is thus only natural that along with various considerations for the increase of production and output of this very important mineral commodity, it is incumbent that careful consideration should be given to the aspect of conservation of the country's coal resources and a practical application made of all such considerations at the earliest possible date

Sir Cyril Fox, a former director of the Geological Survey of India in 1932, estimated the reserves of good quality coal* at 5000 million tons This figure of reserves of good quality coal has since been brought up to date and corrected by various authorities

One estimate places the reserves at approximately 4889 million tons at the end of 1945 and a third at 4520 million tons at the end of 1944

The reserves of good quality coking and metallurgical coals are, however, only a small fraction of the reserves of good quality coals The reserves of good quality coking coals in the Jharia, Raniganj, Giridih' Jainti and Bokaro fields are estimated to be in the neighbourhood of 1180 million tons at end of the year 1944 for seams lying up to a depth of 2000 ft Considering the vagaries of the quality of the coal in the same seam and the exhaustion of some seams in the Indian Coal field it may be possible that the present reserves may be below 1000 million tons, which at the present rate of extraction of approximately 8 million tons per year and taking into account the large losses due to defective methods of winning and working, (and perhaps even considering the advantages to be gained by the scientific blending of the various varieties), may last approximately 70 years Some later estimates point to an addition of about a 1000 million tons in the Jharia fields at depths greater than 2000 ft (2000—5000 ft) But this is said to be on an "admittedly largely hypothetical and possibly optimistic reasoning"

It will be seen from the foregoing how critical is the position with regard to one of the most important mineral resources of the nation and how important and vital it is to take immediate steps for the conservation of our resources of good quality coking coals

Now, conservation of such good quality coking

*Good quality coal being all coals with an average ash content of up to 16 per cent (on a moisture free basis), the coal seams occurring within a depth of 2000 ft , and up to minimum thickness of 4 ft

coal resources can be effected with positive results at the point where the coal is being got at the mine

In the majority of the mines in this country coal is got by a method known variously as "Pillar and Stall method," "Stoop and Stall" or modified "Long wall" method It is well known, and experience in this country has proved without any shadow of doubt, that the loss in mining by this method of working is very high, in some cases this loss runs as high as 50 per cent of the total coal in a mine or property Carlow,[1] in his notes compiled for the American Institute of Mining and Metallurgical Engineers, says "In India, seams 20 ft thick are worked in two lifts and here the extraction percentage is given as 50 per cent" The Coal Mining Committee, 1937,' appointed by the Government of India, estimated that the total waste of coal '*in situ*' in working was about 50 per cent There are many instances where the extraction percentage is as low as that cited above and in numerous other cases the extraction percentage is of the order of 60 to 80 per cent involving a loss of 20 to 40 per cent of the coal at the starting point of the coal cycle, *i e*, at the point where the coal is got from the mine

It must be remembered, however, that the loss enumerated above is only the direct loss on account of the method of working There are other indirect consequential losses in which the coal lost, in some cases, rises to considerable proportions The coal directly lost is usually left in goaves or depillared areas where the roof breaks down, falls and closes in, into the open spaces created by the taking out of the coal in the underground workings With the closing of the roof into the open excavated areas, the coal, left in these excavated areas or goaves, which, in many cases, is of the order of 20 to 40 per cent of the total coal as stated previously, is crushed into powder and this gives rise to conditions suitable for spontaneous heating of the crushed coal This process of spontaneous heating, if left to itself, finally causes fires in the goaves after the lapse of a period known as the "Incubation" period, and these fires tend to propagate in all directions wherever suitable conditions are existing By this process or a process similar to this, large and extensive fires are raging in some of the most important and actively producing coal fields, since most of the coals in this country are known to be spontaneously combustible. In the Jharia coal field, there are active and extensive fire areas known as Jharia fire area, Karejore fire area, Bagdigi fire area etc., involving literally thousands of tons of some of the best qualities of coal available to the nation

Although it is not possible to go into the details, it will be abundantly clear that serious losses occur at the source, *i e*, at the place where the coal is mined These losses are further augmented by areas of coal which have to be left for support of surface features, for support of intermediate strata, for workings underneath waterways or the sea, and on account, sometimes, of an unmanageably great thickness of coal seams and geological disturbances

All these losses could be minimised or completely eliminated by the adoption of stowing, which forms one of the best and most effective answer to all the above problems Assuming an extraction of 60 per cent and cent percent of the total coal without stowing and with complete stowing respectively and an extraction of 10 million tons of High Grade coking coal per annum, the conservation effected in terms of Tonnage of coal, which is lost at present and which would be recoverable by complete stowing during a period of say 70 years, will be of the order of 460 million tons,—an effective increase in the lease of life of about 46 years at the present rate of extraction

In the simplest phraseology, stowing in coal mines is equivalent to packing the vacant spaces made by the excavation of coal underground, with some incombustible material Various kinds of materials have been used such as 'Mutty', 'Morrum,' 'Mutty mixed with small quantities of ash,' but these materials have been used in limited quantities on account of the difficulties in handling them and high cost of stowing by hand labour The material which has been used in very large quantities in India for stowing is sand, on account of its easy availability in large quantities from the beds of the rivers, Barakar, Damodar and Ajoy which run through the two main coal fields of Jharia and Raniganj and from the beds of other waterways such for example, as the river Wardha, from whose bed sand is utilised for stowing at a colliery in the Central Provinces Sand is stowed or packed hydraulically, *i e*, by means of water The sand and water is mixed at the surface in a funnel, called a "separator" and is sent down the shafts to the underground workings in cast iron (in some cases wrought iron) pipes and is allowed to flow out of the mouth of the pipes at a reasonably good velocity at the place where packing is to be done The sand is deposited and retained at the spot required and the water is allowed to flow out into a pre arranged sump whence it is pumped up to the surface to be used again for flushing with sand

This necessarily gives a most elementary idea of hydraulic stowing with sand but it will be apparent that certain obvious difficulties present themselves These difficulties may be (1) the availability of water, (2) the availability of sand and (3) the getting and transport of sand

1 *Availability of Water*—Large quantities of water are required to flush the sand water mixture down the mine to convey the sand to the required spot and to throw the sandwater mixture on to the required spot out of the pipes with a sufficient outflow velocity The quantity required is usually of the order of about 15000 to 26000 gallons per hour, this figure being higher or lower according to the efficiency of stowing, the length of vertical drop in the shaft pipes (stowing), the difference in head between the inbye and outbye ends of the flushing pipes, the ratio of vertical to horizontal, the

[1] World Coal Resources, by C. Augustus Carlow, p 48.

2

total distance of travel of the mixture in the pipes, the placement of the pipes carrying the mixture, i e, whether the pipes have been laid on gradually dipping roadways or have to traverse any rising galleries and on various other factors But in any case, it may be said from experience that the quantity of water required for flushing does not usually represent a serious difficulty for two main reasons One reason is that when the sand water mixture is forced out at the inbye end at the site where stowing is being done, the sand is retained on the spot by artificial barriers or "BOXING" as they are called, consisting in various instances, of bamboo matting held in place by props, old tubsheets and props, cloth brattice held by props and other methods and the water is allowed to flow out by specially prepared channels into suitably constructed sumps whence it is pumped out of the mine by means of a pump or a series of pumps It will thus be seen that the flushing water passes through a cycle of operations and is used over and over again, although it must be said that there are invariably a certain amount of loss during the operations The second reason is that in most mines there is a natural make of water which is utilised for the purpose of supplying flushing water There are few instances where flushing water has to be obtained from outside and in these cases, advantage is taken of any nearby water courses to pump water into storage tanks specially made for purposes of stowing It would therefore be apparent, as has been observed in actual practice, that the question of sufficiency of water supply does not actually present a formidable obstacle in the question of hydraulic sand stowing

2 *Availability of Sand*—The availability of sand and its annual replacement in the beds of water courses in the two main coal fields of Jharia and Raniganj has been the subject of discussion by various workers and authorities In the Raniganj field, the sand bed of the river Damodar is much wider and the depths of the sand in the riverbeds would appear to be greater than in the Jharia field, the depth of sand beds in the Damodar near Ondal may be of the order of 15 to 90 ft while those in the Jharia field are shallower There is also sand available in the Raniganj field from the Ajoy and the Barakar river beds

The Coalfields Committee of 1946 estimated a likely requirement of about 40 million tons of sand on the basis of the Bengal Behar coalfield producing 30 to 32 million tons of coal and assuming a ratio of output of 40 percent in development and 60 percent in depillaring

Taking the figure of fixed sand deposits in Damodar river bed and the older sandy alluvium as estimated by Sir Cyril Fox in 1930 in the case of Jharia coal field at some 170 million tons, an annual replacement of 10 million tons (an average rounded figure based on calculations of various investigators) and an annual final requirement of say 24 million tons for sand stowing purposes, the sand deposits may be exhausted in about 12 years It must be remembered, however, that this will happen only if and when every ounce of coal, be it coking, selected, first, second or third grade coals is raised by replacement with sand In the writer's opinion the aim should, however, be to make an immediate start with conservation of good quality coking coals whose reserves are very limited in this country, while the reserves of inferior grades are almost unlimited On the basis of the Jharia coal fields raising 7 million tons of good quality coking coal, the sand requirements in the Jharia field would be of the order of 10 million tons which would only neutralise all the annual replacements in the river bed

In the case of the Raniganj coal fields, taking the figures given by Dr E R Gee, late of the Geological Survey of India, of a fixed deposit of 936 million tons in the Damodar (543 M T), Ajoy (280 M T) and Barakar (113 M T) and a certain percentage of annual replacement, the prospect is much more bright and does not appear to portend any cause of misapprehension regarding depletion of sand deposits within the next few decades, specially when it is remembered that at the lower reaches of the Damodar in Raniganj coal field, the river easily assumes a width of 3000 ft or more and that every 1000 sq ft of its bed may easily contain on an average a million tons of sand

3 *Sand getting and transportation to collieries*—While no serious difficulties need be apprehended for the excavation of the sand from the river bed by any or some of the various methods of hand or mechanical loading such as Handgetting, Scraper Loading, Dragline Loading, Conveyor belt Loading, Pumping etc, or a combination, extension or modification of these methods and while it will be a simple matter to deliver this excavated sand into the transportation system to the nearby collieries by means of ordinary Rope Haulages, Conveyors, or by a combination or modification of these methods, it may not be so simple to transport the sand to collieries situated at comparatively large distances from the source of supply of the sand i e, from the beds of the water courses.

But even this need not present insurmountable difficulties Various methods for transport of the material are available From a consideration of the long distances involved, the variety of ground that may have to be passed through such as the crossing of main or subsidiary public railways, main or trunk roads, subsided ground due to mining operations, villages or small townships and the large quantities that have to be transported, it would appear that any method of ordinary Rope Haulage may be discounted For the same reasons a method of transport by series pumping of sand water mixture also appear out of the question

The methods that would appear reasonably feasible for transport through long distances would be by Meter gauge or Broad gauge railway system, by Ropeways or by Belt Conveyors Some of the advantages and disadvantages of these system, may be summed up as follows

The main advantages of a Railway system of transport are that it has a greater adaptability while supplying material to points which are situated wide apart and under conditions where deflections may have to be continuously effected, and that, while its capacity could be increased with increasing demand, the supply of material need not necessarily stop on account of any breakdown at any intermediate point in the system

The main advantages of the Ropeway system are that its operation is free from difficulties arising out of unfavourable surface features, its comparatively lower expense on power and personnel, comparatively continuous supply of the material transported and the requirement of comparatively smaller rolling stock for maintenance, repairs and renewals

Conveying by belt conveyors would necessarily be dependent on surface features but a continuous supply of the material will be ensured The transport by belt conveyors to very long distances would also appear to be open to criticism

It would be clear, therefore, that sand getting from river beds and its transport to the collieries situated inland is quite a feasible proposition by any of the following combinations

1 Sand getting from beds of water courses by hand and transporting by Ropeway buckets with a Ropeway transport system or by Railway wagons with a Railway transport system

2 Sand getting mechanically by scraper and transporting by a Ropeway transport system or by Railway transport system

3 Sand getting from beds of water courses mechanically by means of pumps, drying the wet sand by squeezers and other dryers, and subsequently transporting the sand mechanically by a Ropeway or a Railway transport system

The capital expenditure in any of these systems of getting and transport will depend, as may be easily understood, on the type and magnitude of the plant, which in its turn will depend on the quantity of sand dealt with and the distance transported The working cost will also depend on various factors such as the type of plant used for getting and transporting material, the quantity of and the distance to which the material is transported A very general idea may be obtained from the following approximate estimates for dealing with say 20,000 tons of material per day and transporting it to an average distance of 10 miles by the above combinations of methods on the assumption that firstly direct pumping, separating and drying is adopted in the case of excavation by pumping, secondly higher capacity Bicable ropeways are adopted for fairly long direct lines of communications while Monocables are used for diversions into particular collieries or group of collieries for supply of sand, it being a debatable point whether it is more convenient in a particular set of circumstances to install a few heavier Bicable Ropeways or a larger number of lighter Monocable ones

Methods	Capital cost in crores of Rupees	Recurring and operating costs per ton
1 (a) Hand getting and transport by Railways—	3 3	Rs 1- 4-6
(b) Hand getting and transport by Ropeways —	3 3	Rs 1- 2-0
2 (a) Scraper loading & transport by Railways	2 33	Rs 0-13-6
(b) Scraper loading & transport by Ropeways —	2 33	Rs 0-11-0
3 (a) Pumping, drying & transport by Railways -	2 30	Rs 0-14-0
(b) Pumping, drying & transport by Ropeways -	2 30	Rs 0-11-6

The figures for capital costs cannot of course be estimated with any great degree of exactitude as the supply of sand to various collieries or any group of collieries will almost invariably involve a large number of distributed and staggered points and the capital cost will depend entirely on the particular circumstances in a certain area and the type, number, capacity and alignment of the Ropeways or Railways installed

The figures for capital and recurring costs do not also take into account the rehandling of the material which sometimes has to be done when the sand is stocked at the river bank after being excavated from the river bed, such double handling invariably increasing the overall cost per ton and also the capital cost when additional machinery has to be installed with a view to excavate the stocked sand and transport it into bunkers ready for loading into Ropeway buckets or Railway wagons

None of these difficulties therefore are insurmountable and judicial planning could get over all the difficulties that may be met with in the introduction of cent per cent stowing in all collieries working high grade coking coals

From the foregoing it will be abundantly clear that our position with regard to the reserves of good quality coking coals is extremely serious, that the appreciably large and serious losses incurred in extracting seams of this variety of coal can be minimised or completely eliminated by adoption of compulsory sand stowing thus increasing the life of such meagre reserves by a few decades, and that the difficulties that may be encountered in the adoption of compulsory stowing in mines working good quality coking coals could be easily overcome on the lines suggested herein

It is accordingly suggested that immediate measures are urgently necessary to legislate compulsory and cent per cent stowing in all collieries working good quality coking coals to start off with and to put into immediate effect plans on the lines suggested

herein, to supply sand to collieries where it is not easily available for stowing purposes, for the purpose of the implementation of such legislation, keeping in view the further subsequent step of carrying forward such legislation and schemes of sand supply to apply to all collieries working good quality coals in general in the immediate future

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BACTERIA IN PLANT DISEASES

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THE discovery as to the association of bacteria in plant diseases is traced back to the year 1881, but this particular branch of plant Pathology has not made as much progress as other allied branches, relating to fungi or viruses The bacterial diseases in nature are comparatively few in number and do not spread so quickly as fungi or viruses and cause serious epidemics Moreover, for studying bacteria, they demand complicated and laborious methods in the laboratory and do not lend themselves to quick routined procedures Therefore, this subject has attracted only a comparatively few plant pathologists Moreover, on account of little morphological differences existing among bacteria, they have not attained a stable system of nomenclature and the plant parasitic bacteria undergo a frequent change in their names As a consequence, a particular bacterium is now called differently according as one chooses to follow one system of classification or the other

CLASSIFICATION OF PHYTOPATHOGENIC BACTERIA

The three broad groups of bacteria, such as Cocci, Rods, and Spiral forms, as originally proposed by Ehrenberg in 1838, are still recognised Out of these, neither Cocci nor the Spiral forms are concerned with the diseases of plants Even amongst the rod forms, the acid fast bacterium, *e g*, *Mycobacterium*, or any of the spore forming bacterium, *e g*, *Bacillus* and *Clostridium* is known to cause plant diseases But there are only two spore forming bacteria, *e g*, *Bacillus mesentericus* and *Bacillus polymyxa*, which are reported to have pathogenic abilities (Dowson 1943) in as much as they are able to induce primary rots in potato tubers The majority of the plant pathogenic bacteria are gram negative except the only seven species and they may either be motile or non motile with polar or peritrichous flagella

A system of classification for bacteria was proposed by Migula (1900), in which the plant pathogens with polar flagella were placed in the genus *Pseudomonas* and the others with peritrichous flagella, in the genus *Bacillus*, and leaving the non motile forms, with the genus *Bacterium* Smith (1914) while agreeing with Migula regarding the genus *Basillus*, suggested the name *Bacterium* for organisms with polar flagella and *Aplanobacter* for organisms without flagellum Subsequently Lehmann and Neumann (1927) placed all the gram negative and non sporing rod forms in their genus *Bacterium*, which they further subdivided into two subgenera, namely, *Bacterium* proper and *Pseudomonas*. The former included the peritrichous and latter, the polar types Therefore the name *Bacterium* has been used by these authors for three different forms Accordingly, while naming a plant pathogenic bacterium, it has been necessary to say, what system of classification has been followed However, in Bergy's system (1939) attempts were made by the Committee of the Society of American Bacteriologists to simplify the classification of the plant pathogenic bacteria and to remove these confusions as far as possible In this key, a new genus *Erwinia* was proposed for the peritrichous forms, leaving the bulk, whether motile or non motile, in the genus *Phytomonas*

Bergy's system was followed until recently, when it was recognised that the key proposed therein is highly artificial having no regard to the natural affinities of bacteria This received a number of criticisms from many Bacteriologists The acceptance of the genus *Erwinia* became untenable on the ground that the genus was based mainly on one character, that is pathogenicity for plants The genus *Phytomonas* also contained heterogeneous groups of bacteria and included both gram positive and gram negative types. Dowson (1942) stressed that the Gram's staining is the reflection of fundamental difference between the proteins of the two groups of bacteria and pointed out that a genus should not include both gram-positive and gram-negative organisms He (1942) traced the affinities of gram positive plant pathogens with the diphtheria bacillus and the other diphtheroids and placed them in the genus *Corynebacterium*, Similarly

he also (1939) pointed out the affinity of the soft rotting bacteria with the colon bacillus and of the green fluorescent plant pathogens with other saprophytic forms such as *Pseudomonas fluorescens* Migula But, the genus *Pseudomonas* as used by Migula was considered too wide and contained both green fluorescent types with a tuft of polar flagella as well as the yellow forms with a single polar flagellum Therefore, for the latter, Dowson proposed a new genus *Xanthomonas* The soft-rotting types having affinities with the colon bacillus were kept in the genus *Bacterium*, which was defined further not to make it as comprehensive as originally described by Lehmann and Neumann This system of classification has now received a wide acceptance and places the plant pathogenic bacteria into four genera as follows — *Corynebacterium* Lehmann and Neumann, *Pseudomonas* Migula emend Dowson 1939, *Xanthomonas* Dowson 1939, and *Bacterium* Ehrenberg 1828 emend Dowson 1939 To these, recently Conn in America has added a new genus *Agrobacterium*, which includes the gall forming bacteria such as *B tumefaciens* & *B rhizogenes*, but this proposal is yet to receive a wide acceptance

Genera of Plant Parasitic Bacteria

1 Corynebacterium Lehmann and Neumann

Club shaped at one stage or the other, gram positive with barred or uneven staining at certain stages, non sporing, and usually non motile Utilise a large number of carbon compounds including petroleum and paraffin Seven of these produce specific diseases in plants, the important of which are *C fascians* (Tilford) Dowson, causing fasciation in plants, *C sepedonicum* (Spieckermann) Dowson, causing ring rot in potatoes and *C michiganense* (Smith) Jensen, causing bacterial canker of tomatoes

2 Pseudomonas Migula emend Dowson 1939

Rod shaped, non sporing, gram negative, motile rods with a tuft of polar flagella and producing a yellow green pigment fluorescein in certain media Biochemically less active than Bacterium and under certain conditions not being able to split even maltose or salicin The familiar examples are *Ps morus prunorum* Wormald, causing diseases of stone fruits and *Ps phaseolicola* Burkholder, causing halo blight of beans

3 Xanthomonas Dowson 1939

Rod-shaped, non sporing, gram negative and motile with a single polar flagellum and producing a slimy yellow growth on certain solid media Most of them split both fat and the starch The examples are *X malvacearum* (Smith) Dowson, the cause of angular leaf spot in cotton, *X solanacearum* (Smith) Dowson, the cause of wilts in tobacco, tomato, and egg plants and *X citri* (Hesse) Dowson, the cause of scab in citrus

4 Bacterium Ehrenberg emend Dowson

Rod-shaped, non-sporing, gram-negative and motile with peritrichous flagella or non-motile variants. Biochemically very active, splitting a large number of carbon compounds, such as sugars, certain alcohols and glucosides like salicin Examples are *B phytophthorum* (Appel) Birgwitz, the cause of blackleg of potato, *B amylovorum* (Burrill) Chester, the cause of fire blight in apples and *B carotovorum* (Jones) Lehmann, the cause of soft rot of carrots and other vegetables

Types of Diseases Produced

Usually four main types of diseases in plants are caused by bacteria They are — 1 Vascular, 2 Parenchymatous, 3 Vascular and parenchymatous, 4 Hyperplastic

1 In vascular diseases the water conducting tissues are invaded and the vessels get choked with masses of bacteria, which multiply by millions Sometimes, they may also produce powerful toxins which hasten the wilt of the entire plant Secondary invaders may also set on disintegration and blackening of the tissues The wilt diseases in tobacco, potato and brinjal are due to the vascular parasite *Xanthomonas solanacearum* (Smith) Dowson So is the case with the wilt of Cucurbits due to *Bacterium tracheiphilum* (Smith) Burgwits

2 In this case, the bacteria attack the softer tissues like the bulbs, tubers, fruits, the cortical layers of the stem, parenchyma tissues of the leaves and also the meristematic tissues of the growing points The rotting of the plant tissues, the common leaf spots and also the so called blights are all due to the killing and disintegration of the tissues The secretion of an enzyme pectinase is responsible for the dissolution of middle lamella and the consequent disintegration of the tissues The soft rots are produced by several species of *Bacterium Pseudomonas* and *Xanthomonas* but not by any member of the genus *Corynebacterium* The familiar examples are *B phytophthorus* (Appel) Burgwitz, the cause of potato black leg, *X malvacearum* (Smith), Dowson, the cause of angular leaf spot in cotton, *B carotovorum* (Jones) Lehmann, the cause of soft rot in carrot and other vegetables and *B amylovorum* (Burill) Chester, the cause of fire blight in apples

3 In this case, bacteria usually invade the vessels at first and subsequently spread to the cortex From the cortex, they again spread to the neighbouring plants or to the other parts of the same plant and cause local lesions after entering through the stomata The potato ring rot organism, *Corynebacterium sepedonicum* (Spieckermann) Dowson, is an example which produces rotting and as well as the wilting *Ps marginalis* (Brown) Stapp also produces marginal leaf spot in Lettuce through stomata and may lead to the invasion of the entire plant under moist conditions

4 In hyperplastic diseases, the affected tissues are stimulated to active and abnormal growths resulting in the formation of galls, tufted roots or crowded dwarf shoots. The crown-gall organism *Bacterium*

tumefaciens Smith & Townsend, stimulates the cambial activity resulting in the formation of extra cortical tissues which are massed together into a gall The hairy root organism, *Bacterium rhizogenes* Riker *et al*, induces the formation of adventitious roots from the infected parts The fasciation organism *Corynebacterium fascians* (Tilford) Dowson, stimulates the growth of dormant buds and leads to the formation of additional stunted shoots resulting in fasciation of Sweet pea The formation of crowded and dwarfed shoots may also result in the Cauliflower of Chrysanthemum Pea or Dahlia

Control of Bacterial Diseases

Bacterial diseases seem to be more restricted in nature than fungal diseases, the chief advantage of the latter being the ability to enter the plant tissues at any place Bacteria can not penetrate the uninjured epidermal tissues of the plant and can only gain entrance through the natural openings such as stomata, lenticels or water pores Therefore the bacterium as a whole is sucked inside the plant and multiplies in the tissues, but in case of fungi, the spores falling on the plant surface germinate and the infection thread or the germ tube penetrates the plant cells For this reason spraying or dusting against bacteria diseases has not been so effective as that against the fungal diseases, where the external coating of fungicide ordinarily kills the germ tubes

But there are certain cases such as the halo blight of beans (*Ps phaseolicola*), canker of tomato (*Corynebacterium michiganense*), and angular leaf spot of cotton (*Xanthomonas malvacearum*), where infections are known to be carried with the seeds Therefore the treatment of the seeds with a suitable germicide has given effective results in controlling such diseases

The rotation of crop seems to be another method by which a measurable success can be achieved within a short time There exists a type of natural control which operates against the plant parasites in the soil The parasitic bacteria invading the soil are soon crowded out and destroyed by the true saprophytes inhabiting the soil, so that the soil becomes free from infection within a year or two But in case of fungi, the organisms can live in the soil for a longer time, usually five to ten years or more and compete with the natural soil dwellers Therefore, against bacteria, which are naturally short lived in the soil, long crop rotations are not needed and one to two years' rotation is usually recommended

Further, in the laboratory cultures, bacteria are usually associated with an ultramicroscopic organism or possibly a virus, known as Bacteriophage This infects and dissolves the living bacteria in culture Our knowledge is no doubt limited as to the behaviour of bacteriophage in soil and its role in controlling the life of the parasitic bacteria But this suggests a useful line of study for controlling the bacterial plant diseases Furthermore, the practical use of the recent discovery relating to Penicillin, is still in an experimental stage and has remained as a matter of scientific interest only

The breeding of resistant varieties has not also progressed as far as that in the case of fungal diseases but surely certain possibilities do exist on these lines of approach However, satisfactory results are obtained by the adoption of prophylactic measures, where good sanitation, use of disease free seeds and manures, destruction of diseased plants or plant parts are followed as a matter of routine

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CAUSES OF CRIME
Psychological Variables*

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THE attempt to determine the Psychological causes of crime is a fascinating study indeed but it is at the same time an extremely difficult task to carry through And the difficulties make themselves felt right at the start when we begin to form in our minds clear conceptions of what constitutes crime and who are really criminals We all believe of course that we know definitely what sort of action is a criminal action and who is a criminal but we shall see presently that our convictions on these matters rest rather on insecure foundation and that our uncritically accepted opinions do not always justify themselves For purposes of law, to violate any one of the existing codified criminal law is a crime and the person who commits such a breach is a criminal But are these definitions adequate? Would that not imply that in communities where there are no codified laws—there are such communities – there cannot be any crime committed? If all laws, let us assume, were proclaimed by our Government and Legislatures to be abolished from the midnight of today, would crime also simultaneously disappear from society from that zero hour? Certainly not There will still be actions which would be considered criminal and even though there be no legal sanction for punishing criminals society would see to it that criminals get the type of punishment which it considers they deserve That only shows that in framing our judgements about crimes and criminals we have to take other factors, besides the legal one, into consideration. What are those other factors? First and foremost we think of the social factors All criminal acts are antisocial acts though of course it should be at once remembered that all antisocial acts are not necessarily criminal acts What then is an antisocial act? Let us see

Very broadly speaking a society is an organized group of persons living in a particular place, having some common ideas and ideals, purposes and sentiments and following in their behaviour certain customs and traditions handed down to them from previous generations The degree of organisation of societies varies in different parts of the world A survey of mankind from China to Peru easily reveals that there are different levels of social development and that there exist different types of society amongst the masses of men which constitute the sum total of humanity The beliefs and traditions accepted by one group as constituting the sacred bases of their society are irreverently condemned by another group adopting, it may be, precisely the opposite views and ideas as forming the foundations of their society. Such instances are not rare at all and any student of sociology and social psychology will easily be able to cite numerous illustrative examples We need not here enquire into the reasons for these fundamental differences in the customs and traditions of different societies If we only bear the fact of this difference in our minds we shall be in a position to understand why a particular act, Harikiri, is almost a virtue in one country while even the attempt to do it is considered criminal in another

At the back of the acceptance of the traditions and adoption of the customs by particular societies lies the conviction that somehow these customs and traditions contribute towards the welfare of the respective societies and the happiness of the individuals comprising them As the accepted standards are believed to be capable of bringing about all round happiness society demands from its individual members strict conformity to those standards of life and conduct Non-conforming actions are regarded as antisocial

It need not be doubted that the majority of the members easily and quite willingly obey the prevailing customs of society and experience no difficulty at all in following the current standards of morality But we very often forget in our practical life about a fact which we only too readily recognise when stated as a theory No two men are alike Like all other attributes the temperament of every person differs from that of another Statistically speaking while the majority of the persons living in a society may exhibit a central tendency in temperamentally reacting to a situation some percentage of them may normally be expected to show considerable variation in their reactions It is in these individual differences of temperament and other attributes in the mental make up of men that we have to look for the psychological factors in the causation of crime Let us remember then that there are everywhere persons, who, because of their psychical constitution, find it extremely difficult to adjust themselves to the prevailing social and cultural standards of the place they are born and bred up in It is a psychological fact, the truth of which a little reflection on one's own experiences may make every one realise for himself, that in order to meet the demands made on us by society, we have often to renounce many a pleasure which we would fain enjoy This act of renunciation is not always an easy one and is often responsible for generating severe conflicts in the minds of the individuals The state of conflict, however, cannot endure for any great length of time, for the tension that is experienced in connection with the conflict is an intensely unpleasant experience and has to be resolved soon in some way or other for the preservation of the mental integrity It is in the nature of these conflicts and the way they are solved that roots of criminality in some cases and seeds of neurosis in others are found.

There is a direct way of facing conflicts. We may

*Radio talk delivered on Sunday the 11th July, 1948 Published by the kind permission of All India Radio.

fully admit to ourselves that the desire that we are experiencing at the present moment is immoral and selfish and we may deliberately decide within ourselves in favour of not indulging in the desire because we feel convinced about the harmfulness of gratifying such a desire The man who can consistently carry out such adjustments throughout his life may be described as a perfectly normal individual Such a perfect man, however, is definitely a rarity Even when we convince ourselves that we have the selfish desire, it lives within ourselves in the unconscious region of our minds and from there continues to exert its influence on our thoughts and actions I do not like the gentleman and there is a definite desire in me to ill treat him But I realise also the unworthiness and the absurdity of my tendency I deliberately resolve to mend my ways The result is that my behaviour towards him is certainly polite and respectful but I feel greatly delighted when he is discomfited in some way and vastly enjoy all jokes against him That only shows the underground persistence of my hostile tendency against him

Another way of meeting such situations is the devising of means so that the conflicting tendencies may not meet together It is reported that a member of a certain profession—I deliberately refrain from mentioning the profession out of my innate regard for it—used every morning to sit for his *Pujah* and made it a point to observe strictly all the rites and ceremonies connected with it and the injunctions prescribed by the *Shastras* For his meticulous observance of these rites even at the cost of physical suffering he was considered to be a deeply religious person by many a man who never had the misfortune of coming into contact with him in any matter connected with his profession His *Pujahs* lasted however everyday till 9-30 a m after which period he was definitely a different personality His extremely clever counsels and ingenious insinuations never caused any one to suspect that he ever has any fascination for the ethical codes and the religious principles embodied in the *Shastras*

A third way of meeting conflicts is by developing psychoneurosis, which essentially is a compromise formation between the repressing tendency and the repressed desire A child has the sense that greater attention is paid by his parents to his younger brother He resents it and feels jealous He knows however that jealousy is a vice He begins to suffer from chronic illnesses which require constant attention to be paid to him by the parents The child's desire is fulfilled Such happenings it should be remembered are not confined to the children alone

Just as a psychoneurosis may develop out of such a situation it is extremely important to realise that a criminal tendency may result exactly from similar conditions When a child feels strongly that he is not getting the love from his parents that he deserves and expects he may develop an extremely unfortunate tendency which when expressed in the language may be put in the following way "You dont love me, well, all right, I dont want your love I dont want anybody's love Even when I do something which is approved by you, you do not appreciate my endeavours, henceforth then I wont care for your approval, I shall do whatever pleases me I would not care for anybody's approval either" One easily realises that there is only a very short step leading from this defying of parental authority to defiance of civil and social authority, or in other words to criminality

Poverty has often been emphasised as a cause of theft and other criminal activities We have no intention of denying the urgent necessity of improving the social, economic, and environmental conditions of the poverty stricken, but why does a rich society lady who has never known in her life what the term "want" signifies steals some trifles from the shop, which she never makes any use of? It has been made abundantly clear that poverty itself is not the direct cause of criminal behaviours but the psychological factors which often operate in poor families and neighbourhoods are mainly responsible for generating criminal tendencies Neglect by the parents— mother works in factories or elsewhere from morning till night, father spends his leisure in drinking and gambling—association with delinquents of the neighbourhood, it is these which lead to criminal behaviours, and these are psychological factors

There was once a theory that every criminal was a born criminal We have outlived that theory and we have also ceased to believe that all children are born angels We have however to recognise that every child is born with all those impulses, *viz* jealousy, sex aggression, egoism, etc , which if not properly adjusted may easily lead to the development of criminal habits

As punishment is not the topic of my present paper, I shall only briefly mention here that in order to be effective, punishment also should be based on psychological considerations It is now a known fact, however strange it may seem, that many of the impulsive activities of children spring from a desire to be punished and in such cases punishment, as it is usually afforded, only strengthens the mischief making impulses of the children and the criminal propensities of the adults

Let me close my talk by citing an actual example recorded by East Hubert which will show how psychological factors may lead to criminal activities A man, aged 28 years, was imprisoned for 6 months for unlawfully effecting a public mischief Examination revealed that his father was violent and mother intemperate, the home was neglected and he was removed and placed in the care of a charitable organisation at the age of twelve, he returned home when he was 15 years old At the age of sixteen he was convicted of housebreaking, larceny and malicious damage to property and was sentenced to Borstal detention He joined the Army on release and served abroad—he alleged he was sent overseas as he accused a N C O. of sodomy Some time later he was tried by court martial for shooting at a N C O in barracks. He appeared to have no rational cause for the act and was

sent to a mental hospital and was later discharged from the Army He obtained employment and about two years later was sentenced to nine months' imprison ment for uttering a letter threatening to murder a man on the grounds of alleged indecency Several months later he sent a threatening letter to the wife of a later employer alleging she had murdered her husband He stated he made the allegations because he was unable to keep his situations and wanted to be arrested He signed the letter and on each occasion gave his address His bodily health was good He was solitary and in troverted and had some insight into his condition He felt he was two persons and that one gave instruc tions to the other He said he was quite willing to have homosexual attacks made upon him in the Army He was unable to concentrate and was depressed He felt increasingly powerful urges to murder someone and was much afraid that he would do so and also commit suicide He drifted away from reality into his phantasies and became more and more detached He was later certified as a person of unsound mind Later he became hallucinated, violent and catatonic and was certified as a person of unsound mind He was an excellent example of a man whose developing mental malady led to a great deal of criminal be-haviour

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PLAGUE EPIDEMIC IN CALCUTTA

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THE occurrence of indigenous Plague in Calcutta in the summer of 1948, after a respite of more than 35 years, has made the citizens 'Plague-minded' The likelihood of a recrudescence of this disease during the coming winter and summer months is not ruled out by competent authorities

It is thus an interesting study to examine the characteristics of the disease, the influence of the va rious seasonal factors upon its intensity and spread and variations in the death-rates on the basis of age, sex etc due to this disease which raged in a more or less virulent form in Calcutta for more than a decade at the beginning of the present century The data, given here, have been obtained from the book "The Calcutta Plague (1896 1907)"—a Thesis submitted by Dr H M Crake, Asst Special Health Officer, Calcutta, for his doctorate degree in medicine It may be added that the Plague epidemic visited the city regularly for several years after 1907

As a disease may show an erratic behaviour at the time of its first outbreak as also during its decli ning stages, the data for the year (1903 04) which were available in all necessary details and the data for 1905 have been examined in this paper

The number of attacks recorded per month is admittedly an under statement and hence the number of deaths and the death rate per month have been studied in conjunction with the seasonal factors pre-vailing during the month in question, in Section A The procedure adopted has been to find the total and the partial correlation coefficients between the mon-thly death rate on the one hand and the Mean Tem-perature (x_1), Mean Temperature Variation (x_2) and the Mean Humidity (x_3), averaged over the whole month in question, on the other, eliminating, as re-quired, the effects of one or more seasonal factors in the case of the partial coefficients

In Section B the age-groupings and the sex of the persons attacked and deceased have been taken for the year July, 1903 to June 1904, as the data for other years are not available in the book It has been attempted to establish any significant variation in the attack and death rate in the different age groups and in the different sexes

SECTION A

TABLE I

Month	Monthly death rate	Mean Temp	Temp Variation	Mean Humidity
1904	(y)	(x_1)	(x_2)	(x_3)
Jany	0 076	66 1	23 8	66
Feby	0 380	70 9	23 6	62
March	1 781	80 6	22 3	62
April	2 247	86 3	17 8	72
May	0 662	85 0	16 6	75
June	0 154	84 8	11 8	84
July	0 045	82 7	8 9	87
Aug	0 029	84 0	9 9	84
Sept	0 009	83 4	11 5	82
Oct	0 012	80 8	14 9	77
Nov	0 040	73 6	17 8	72
Dec	0 080	68 0	20 2	71
Total	5 515	946 2	199 1	894
1905				
Jany	0 260	65 5	20 6	71
Feby	0 521	65 1	21 1	60
March	2 415	76 7	18 6	74
April	3 609	81 5	19 5	73
May	1 254	84 4	15 1	78
June	0 193	89 0	16 0	75
July	0 059	83 3	10 3	86
Aug	0 055	84 1	9 0	86
Sept	0 074	83 3	10 2	85
Oct	0 034	81 2	12 5	81
Nov.	0 101	73 5	19 7	70
Dec	0 101	67 1	21 9	66
Total	8 676	934 7	194 5	905

Here

y = monthly death rate, due to Plague, per thousand, calculated on a total population of 8 5 lacs,

x_1 = daily Mean Temperature,
x_2 = daily Variation of Temperature,
x_3 = daily Mean Humidity,
} all averaged over the whole month

The values of the total and partial correlation coefficients from the data for each of the years, 1904, and

1905 as well as the significance or otherwise of the improved estimates of the values on combination of the results of the two years are given below —

Corr Coeffs	for 1904	for 1905	Combined estimate
$r_{x_1x_2}$	−0 004	−0 745	significant
$r_{x_2x_3}$	−0 979	−0 943	significant
$r_{x_3x_1}$	0 661	0 780	significant
r_{x_1y}	0 336	0 098	insignificant
r_{x_2y}	0 344	0 328	insignificant
r_{x_3y}	−0 433	−0 170	insignificant
$r_{x_1y \cdot x_2}$	0 867	0 543	0 749 significant
$r_{x_1y \cdot x_3}$	0 841	0 374	0 670 significant
$r_{x_2y \cdot x_1}$	0 869	0 604	0 768 significant
$r_{x_2y \cdot x_3}$	−0 435	0 511	insignificant
$r_{x_3y \cdot x_1}$	%0 855	−0 395	−0 689 significant
$r_{x_3y \cdot x_2}$	−0 501	0 443	insignificant
$r_{x_1y \cdot x_2x_3}$	0 812	0 462	0 672 significant
$r_{x_2y \cdot x_3x_1}$	0 302	0 572	insignificant
$r_{x_3y \cdot x_1x_2}$	−0 042	0 324	insignificant

It thus appears from above that x_1 and x_3 tend to increase or decrease together while the reverse is the case with x_1 and x_2, x_2 and x_3 The total correlation coefficients show that with increasing x_1 and x_2, y tends to increase while with increasing x_3, y tends to decrease, though in no case is this tendency significant

The combined estimates of the first partial coefficients show that the correlation between y and x_1, eliminating the effects of x_2 or x_3, is positive and strongly significant on 5 percent level and that between y and x_2 or x_3, eliminating the effect of x_1, is also strongly significant, the first positively, the second negatively, while the other first partial derivatives of y with x_2 or x_3 are not significant

The second partial correlation coefficient of y with x_1, eliminating the effects of both x_2 and x_3, is positive and strongly significant, while the other second partial correlation coefficients are not significant

Thus, for example, an increase in the Mean Temp tends to increase the death rate, but at the same time tends to decrease the Mean Temp Variation (causing decrease in the death rate) and to increase the Mean Humidity (again causing decrease in the death rate) Hence the first partial correlation coeff of y (death-rate) with x_1 (Mean Temp), eliminating either of the other two factors, as well as the second partial coeff of y (death rate) with x_1, eliminating both the other factors, are positive and strongly significant, but the total correlation coeff of y with x_1 is insignificant

SECTION B

The following Table gives the age groupings of plague attacks and deaths in Calcutta from July, 1903 to June, 1904 The data are not available for any other year in Dr Crake's book

Assuming 1/163 and 1/173 to be the population values for the case ratio and the mortality ratio, it appears that persons under 10 years are significantly less susceptible and persons over 50 years are significantly more susceptible to attack and death due to this disease

Table II

Age group	Cases	Deaths	Population	Case ratio to pop	Mortality ratio to pop	Limits on 5% level Case ratio	Mort ratio
Under 10 yrs	542	510	120478	1/222*	1/236*	1/152 − 1/175,	1/161 −1/187
10–19	497	888	143440	1/162	1/152	1/153 −1/174,	1/162—1/185
20–29	1172	1093	206407	1/176	1/180		
30–39	973	913	165574	1/170	1/181		
40–49	712	669	109320	1/153	1/163		
50–59	440	424	59965	1/136*	1/141*		
60 over	419	412	42612	1/101*	1/103*	1/144 −1/185	1/153 −1/197
Total	5205	4909	847796	1/163	1/173		

The data do not show any significant variation, due to sex, either in the case ratio or in the mortality ratio

Sex groupings of Plague attacks and deaths from July, 1903 to June, 1904

Sex	Population	Cases	Case ratio to pop	Mort ratio to pop	Limits on 5% level Case ratio	Mort ratio
Male	562596	3527	1/159	1/169	1/158—1/169	1/167—1/179
Female	285200	1678	1/170	1/181	1/156—1/171	1/165—1/182
Total	847796	5205	1/163	1/173		

It may be added that the conclusions arrived at are applicable to the climatic and environmental conditions etc which prevailed in Calcutta during the early part of the present century and which may be taken to prevail in modern times as well

* In the ten years' study of plague cases, as given in Dr Crake's book (from 1898 to 1907), it is found that every year plague attacks and deaths started increasing from January, attained a peak in March or April, began to diminish and passed into the 'quiescent stage' in July The period January to June was designated as the 'Epidemic Period' while the months June to December were named the 'Quiescent Period ' Another point of interest to note in the statistical analysis of Section A is that the year 1905 is rather abnormal in the values of the monthly Mean Temperatures In all other years studied the Mean Temperature increased from January to April, while in 1905 the Mean Temperature of February was lower than that in January This accounts for, to a large extent, the rather lower values of some of the correlation coefficients obtained for that year.

JAMES WILLIAM McBAIN

THE choice of Dr James William McBain, F R S, Professor Emeritus of Chemistry of the Stanford University, U S A, as the first Director of the National Chemical Laboratory, Poona is in itself a promise and progress in chemical researches in India

Born on March 22, 1882 at Chatham, New Brunswick, Canada, Dr J W McBain is the son of a Doctor of Divinity and comes of a family markedly believing not only in higher learning but in a religious philosophy of life

All throughout his career Dr McBain has distinguished himself as a lover of knowledge, an instigator of researches, a motive power in scientific pursuits and as a great organiser of scientific researches His eminence as a scientist maintains a very high position in the International Scientific World

Educated in Rhodes Island in his early years Dr McBain had his training for bachelor's and master's degrees at the University of Toronto, wherefrom he obtained A B in 1903 and M A in 1904 After a period of post graduate study at Leipzig University (1904 05) and at the University of Heidelberg, Dr McBain obtained Ph D degree in 1906 and soon after actively associated himself with plans for the new University of Bristol, England, where he joined as Lecturer in Physical Chemistry At the University of Bristol he achieved such distinction that a new professorship was established in 1919 by Lord Leverhulme to hold him down This practical device, however, worked for but seven years only, and in 1927 Dr McBain accepted an invitation from the Stanford University, California as Professor of Chemistry

While at Bristol he was a Captain of the Territorial Force, with 3rd Officer Cadet Battalion for the period 1911-19, and was mentioned for distinguished services in 1917 Also during World War I he was attached to the Ministry of Munitions, Great Britain As a Captain, he earned the credit of training 1,300 Officers for the Service

His contributions to scientific knowledge are voluminous and valuable from the point of view of both theory and application Dr McBain has made many outstanding contributions to varied problems of Physical Chemistry He has published more than three and a half century of papers of merit and application, covering practically every phase of the science of colloids A major portion of Dr McBain's efforts has been devoted to the fundamentals of the behaviour of soaps

The comprehensive projects in which Professor McBain and his group of co workers are interested are

(*a*) The theory of colloids, a group of experimental studies towards deciding outstanding problems in the science of common, every day materials, for the study of which adequate experimental and theoretical methods have only recently been developed These include use of the McBain sorption balance and the McBain spinning top ultracentrifuge,

(*b*) A complete study of the behaviour of soaps and their solutions (36 years of intensive work have been given to this subject with widely recognized results but the greater part still remains to be done)

(*c*) The elucidation of the structure and properties of surfaces, *e g*, their composition and mechanical arrangement, their electrical properties, their dissociation and conductivity and the development of their thermodynamic theory Surfaces are universal in all common materials, including all living matter, and playing a predominating role in life processes

JAMES WILLIAM McBAIN

(*d*) The nature and mechanism of adhesives and adhesive action—the only systematic study which is being made in this field The work was initiated on behalf of the British Government The results, like those of the previous projects, find close relations to problems of biology and colloids

(*e*) The nature, mechanism and laws of adsorption

(*f*) The dissociation theory of salts in aqueous and nonaqueous solutions, experimental studies towards the broadening and unification of the treatment of this subject, at present almost wholly neglected except from the standpoint of the assumption of 100 percent dissociation of the simplest salts in aqueous solution

During his stay in England Dr McBain served as an honorary advisory member on Dental Investigation Board, Corrosion Committee, Building Research Board, Adhesives Research Board, Laundry Research

Committee etc He was elected Fellow of the Royal Society of London in 1923, Fellow of the Institute of Chemistry and a Fellow of the Institute of Physics He was awarded the Davy Medal of the Royal Society in 1929

Dr McBain is a member of the American Association of University Professors, the Association of University Teachers, Great Britain (President 1922-23), Bristol University Alumni Association (President 1923 26), Bunsen Gesellschaft, London Chemical Society, Society of Rheology, Faraday Society (Vice President 1926 29), American Chemical Society (Chairman, California Section 1930-31), American Association for the Advancement of Science, British Association for the Advancement of Science, Colloid Committee of the National Research Council He is also the Associate Editor of the *Journal of the American Chemical Society* and the *Journal of Physical Chemistry*

Besides scientific papers and articles Dr McBain is the author of the following standard books (1) The Sorption of Gases and Vapours by Solids, George Rontledge & Sons Ltd, London 1932, (2) Colloid Science, An Introduction to the Study of Organized Matter, Health & Co, Boston (*in press*), and (3) Solubilization, Its Relation to Hydrotropy etc (*in preparation*)

Dr McBain will assume charge of his new appointment in October next

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Notes and News

OBITUARY - HOWARD S FAWCETT

Dr Howard S Fawcett, Plant Pathologist of the California University and California Agricultural Experiment Station, stationed at the Citrus Experiment Station, Riverside, California, U S A, died in Riverside on December 12, 1948, at the age of 71

Born in Salem, Ohio, Dr Fawcett received his education at the Iowa State College and at the University of Florida, and was awarded his doctorate from the John Hopkins University in 1918 He began his career in 1906 as plant pathologist in Florida, then accepted in 1912 an appointment with the California Commission of Horticulture, and a year later in 1913, he joined the staff of the California University and the California Agricultural Experiment Station

Dr Fawcett was widely known all over the world for his work on citrus diseases, he was the author of innumerable publications, including his monumental book, "Citrus Diseases and Their Control"

USE OF ISOTOPES IN MEDICINE

Dr Paul C Aebersold furnishes specific data on distribution of isotopes for medical and biological purposes during the past two years Isotopes were distributed from Oak Ridge, Tenn From August 1946 through May of 1948, 21,103 shipments of isotopes for study in animal and human physiology and medical therapy were made Fortythree institutions are now using phosphorus of P 32 for medical therapy, 38 institutions are using iodine in medical therapy, 119 institutions are using several of the isotopes in all fields of study including investigative and therapeutic application

Over 70 per cent of all shipments have been for investigation in therapy and human physiology, the remaining fields of study have been in chemistry, physics, industrial research and metallurgy Of those used more in medical therapy, I 131 and P 32 account for the greatest part inasmuch as the half life of these I 131 (eight days) and P-32 (14 days) permit a much greater rapidity of decay and therefore shipments are required more frequently Isotopes are being shipped to 30 States in the United States, the largest amount is at present going to Massachusetts Illustrations of uses of C-14 in metabolic studies include (1) Protein metabolism with labelled amino acids—leucine, glycine, lysine and amino adipic acid, alanine, (2) Carbohydrate metabolism with labelled intermediates such as lactic, pyruvic, oxalacetic and proprinonic acid and (3) Fate of labelled fats

Other illustrations of uses of P 32, S 35, Ca-45 are also mentioned The author mentions the fact that investigators in foreign countries can obtain isotopes by application through the Commission Twentynine radioisotopes of 20 elements which are of particular value in biological and medical studies are available It is stated that although international distribution has been in effect only 10 months, shipments have already been made to 14 countries The author considers that these studies are opening a new field for specialization known as "isotopology," Although the use of these substances can be fraught with hazard there has been collected a large amount of knowledge

on how to control them and with this knowledge and a healthy respect for the materials to be handled, safe conditions of work can be easily established (*Journal of the American Medical Association, 138*, 1222 1225, December, 1948)

URANIUM DEPOSITS IN THE U S S R

Russian research on radioactive minerals began in 1900-1903 with the work of I A Antipov in the Fergana Valley of Russian Central Asia Field work in 1914 indicated the presence of deposits of sufficient quantities in two areas with possibilities of commercial development One was Tyuya Muyun in the Fergana Valley with deposits of *tyuyamunite*, Ca $(UO_2)_2 V_2O_8$ $6H_2O$, closely comparable to the carnotite of the American South West The other was the North West slopes of the Khamar-Daban Range, especially near Slyudyanka and along the Trans Siberian railroad between Baikal and Kultuk, characterized by sites rich in *mendelyeevite*, with the probable composition, $2CaO\ 2(Ti,\ U)O_2\ (Nb, Ta)_2O_5$, strikingly similar to be tafite and allied niobium-tantalum uranium minerals of Madagascar Between 1908 and 1913, at Fergana the ore mined was 2,008,000 pounds, 1,512,000 pounds of which has been sent to its plant in Leningrad for refining The ore contained on the average, 2 36% V, 0 97% U_3O_8 and 3 73% Cu

The Tyuya Muyun deposit was a vein field in highly metamorphosed Paleozoic limestone, closely associated with extensive karst channels and caves The vein field consists of at least five barite ore veins bearing uranium, vanadium, and copper minerals and of over 30 pure barite veins The barite veins extend up to 1,500 meters from the center of the deposit, the maximum depth of the main vein may reach 500 meters Run of-the-mine ore averages 1 5% U_3O_8, with a range of 0 6 to 4 0%, the higher values being found in the lower horizons The uranium oxide content of the amorphous, brown, cupro-uranium carbonate lenses runs from 26 12 to 50.25% The mine produced 534 metric tons of hand sorted ore in 1925 26 By 1936, the quantity of radium extracted from these ores and from radioactive waters near Ukhta was sufficient to meet the needs of the Soviet Union

In 1937, an important ore deposit was found at Agalyk in Central Asia, but the geology of the site was not clearly known In 1940-41, the presence of uranium was established in a vanadium site in the North Western tip of the Karatau Range It represents a sedimentary deposit with subsequent metamorphism which created a reiterated interbedding of thin bands of vanadium ores (with uranium-mineral accumulations) with flint bands The total amount of uranium in the ore body (which extends for 25 30 km, with a thickness of 10-14m) was great

In the area of the Khamar-Daban Range, mendelyeevite was found in two phases, crystalline and amorphous, with differing compositions and physical properties Total uranium oxide content in all samples ranged from 19 70 to 28 90% The discovery of three major phlogopite mica deposits in the Aldan gold field area—Emeldzhik, Kuranakh, and Chuga or Ust Nelyuka—indicated the probability of corresponding uranium finds to an unknown degree Great importance was also attached to the Ukrainian magnetito ortite pegmatites, particularly in the areas of Novograd Volynskii and Berdyansk Mariupol

Soviet discoveries of uranium in Central Asia within the last decade would provide a possible basis for the development of atomic power in that area Moreover, all of the Central Asiatic deposits were found within a radius of 250 miles from the important hydroelectric plants of the Tashkent area, which produced 882,000,000 kilowatt hours of energy in 1943 There were also great possibilities for the discovery of significant uranium deposits associated with pegmatites in the region between Lake Baikal and the Aldan gold fields and in the Ukraine (*Science*, January 21, 1949)

NEW MACHINES FOR ATOMIC RESEARCH

Two new machines have been built at the Brookhaven Laboratory, Upton, Long Island, New York Dr M G White, the director of the laboratory, stated that the cosmotron, one of the machines, will be used to bombard the nuclei of atoms with atomic particles at energies of 2500m to 3000m electron volts or 10 times greater than the most powerful synchro cyclotrons at present in existence The other machine was an electric furnace costing $20 million to construct The intensity in the neutron radiation in the centre of the pile was such that five trillion neutrons a second would pass through every square centimetre of surface exposed The details of these machines were revealed at the annual meeting of the American Physical Society at Columbia University (*The Chemical Age*, February 12, 1949)

FOREIGN SCIENTISTS INVITED TO NUCLEAR STUDY INSTITUTE

The radioactive isotope training facilities of the Oak Ridge Institute of Nuclear studies have been opened to a limited number of foreign scientists who plan to use radioactive isotopes in their research The Institute, composed of 19 Southern universities, through a contract with the Atomic Energy Commission conducts a broad programme of research and training in the nuclear sciences

Applications are received by the State Department through the Washington Embassy of the country of origin and are accepted from citizens of nations which are qualified to receive radioactive isotopes The course is completely unrestricted and is limited to the use of radioactive isotopes in research It has no relation to classified use of atomic energy.

NEW PROCESSES OF LOW-COST FRENCH PILE

France has completed a self sufficient atomic energy pile at a price of only 3 billion francs, far less than U S and British appropriations for similar projects The pile was begun three years ago and is in operation in Fort de Chatillon, near Paris France hopes to trade several novel processes used in the construction of the pile with other nations for raw materials or other secrets, stated Frederic Joliot Curie, Head of the French Atomic Energy Commission He also emphasized that competitive commercial secrets rather than military secrets are involved Research will be devoted to radioactive isotopes for medical, biological, and industrial purposes, harnessing of atomic energy for heat and electrical power, and protection from atomic explosions

Heavy water, said to have been obtained from Norway in exchange for technical information, is used rather than graphite as a restrainer Commercial quality graphite is scarce in France, and industry there is virtually incapable of obtaining the absolutely pure product needed in the piles The uranium for the pile, which is in the form of uranium oxide rather than the metal, is said to consist principally of the stock which Dr Joliot Curie had obtained before the war for his own research The process by which the French have been able to refine this oxide to a higher degree than has ever before been attained is one of the secrets which France is depending upon to augment her bargaining power in the market for atomic raw materials

A much larger installation is already being built at Saclay, another Paris suburb Although it is to use heavy water, metallic uranium will be the raw material (*Chemical and Engineering News*, January 3, 1949)

SILVER-110 FOR ATOMIC MOVEMENT

Radioactive materials were used to trace atomic movement at the General Electric Research Laboratory, New York In a recent experiment, it was found that silver atoms in metallic silver would move between the grains 1/10 in per week at 500°C The experiment was done with a radioactive isotope of silver, called "Silver 110", which was electroplated on the surface of an ordinary silver block After several hours at 500°C, the specimen was cooled and layers of thickness of tissue paper were shaved from the block Each layer was checked for radioactivity with a Geiger counter, to determine how far the tagged atoms had penetrated The radioactive silver-110 was found to be a potent source of detectable beta and gamma-rays These studies would throw new light on the internal structure of metals It was stated that atoms passing through rather than round the grains take about 10,000 years to move an inch (*The Chemical Age*, February 5, 1949).

NOISE THERMOMETER

The world's most accurate thermometer has been designed at the University of Chicago's Institute of Metals Two young physicists have put the noise of bouncing atomic particles to work As the molecules move, they hit free electrons, which bounce off like billiard balls as they are thousands of times lighter As the electrons bounce, they set up small electrical impulses, which can be amplified and measured These amplified impulses can be heard as noise They can also be put to use telling temperature, since they increase with the amount of molecular motion, and, therefore, with the amount of heat As we know, heat is simply the motion of molecules The complicated instrument is called the "Noise" thermometer It converts the noise into pulses which are visible on an oscilloscope, and from which accurate temperatures can be calculated This thermometer can indicate accurate readings between a fraction of a degree above absolute zero (abs zero is minus 459 6F, the point where molecular motion stops, and the noise vanishes) to 5,000F At the high end of the range the thermometer is more accurate than any other type It is completely unaffected by pressure The thermometer is specially suitable for jet engines for determining the high temperature of the exhaust gases and the internal parts of the engine (*Journal of the Franklin Institute*, January, 1949)

PATULIN AGAINST CANCER

Patulin, a water soluble antibiotic, was first discovered as a metabolic product of *Aspergillus clavatus* and was isolated from *Pennicillium claviforme* by Chain in 1942 It was also obtained in cultures of *Pennicillium patulum* Patulin was found to be more toxic to leucocytes and tissues than to bacteria In 1944 Dr Hildegard Vollmar of the Chemotherapeutic Research Institute, Frankfurt, examined the way in which certain bacteria and their metabolic products influenced the growth of cancerous tissues In collaboration with Dr Moll of Messrs E Merck in Darmstadt, Dr Vollmar found that normal skin tissues (in culture) after the addition of patulin in concentration of 1 50,000 was stimulated to an extraordinarily rapid growth, which was even more marked when a more concentrated Patulin solution (1 25,000) was used But if the patulin solution was further concentrated (1 10,000) a growth inhibiting effect was noticed, leading to a complete stoppage of growth when a solution of 1 5,000 was applied

The same stimulating effect of dilute patulin and the same paralysing effect of more concentrated solutions was also observed with white blood cells Dr Vollmar also proved that dilute solutions of patulin, which stimulated the growth of normal tissue cultures, acted as an inhibiting agent when applied to a culture of cancerous tissue After the additions of these solutions (1 50,000 and 1 25,000) the malignant tissues increased by only a very few cells which appeared to be degenerate, The main points of

her experiments were the following (1) the growth of normal skin tissues was accelerated by the addition of dilute solutions of patulin (1 50,000 and 1 25,000), (2) the mobility of white blood cells increases proportionately under the impact of the same solutions, while (3) the growth of malignant tissues in culture was retarded after the application of these patulin solutions Dr Vollmar planned further investigations of this seemingly dual and contradictory effect of Patulin, but she and Dr Moll were both killed in an air raid on Darmstadt in December 1944 The result of their experiments has recently been published in a German scientific journal (*Discovery*, January, 1949)

ATOMIC CLOCK

An atomic clock has been developed at the National Bureau of Standards which tells time by the movements of atoms in molecules of ammonia Parts of the atomic clock include a quartz crystal oscillator, a frequency multiplier, a frequency discriminator, a frequency diver, a special 50 cycle clock and a waveguide absorption cell The cell is a 30 ft copper tube, wound in a compact spiral around the clock and is filled with ammonia gas

The actual clock is electrically driven, world's most accurate electric clock A low frequency radio signal is generated by the crystal oscillator and transformed into a microwave signal This signal is compared with the natural vibration of the ammonia molecule and adjusted to agree with the molecular vibration The resulting signal controls the electrically driven clock

While the atomic clock is in operation, the monitoring oscilloscope continuously displays a trace of the 3,3 absorption line of ammonia The 3,3 line, strongest of many absorption lines in ammonia, corresponds to the quantum transition in which the quantum numbers J and K both have the value 3 The symmetric output pulse is produced by absorption of the FM control signal as it sweeps across the natural absorption line frequency of the ammonia gas The sharpness of this line on the oscilloscope screen is an indication of the time keeping accuracy of the atomic clock The new clock has a constancy of better than one part in 20,000,000 Potential accuracy theoretically is rated at one part in 10,000,000,000

The new clock is independent of astronomical calculations and promises advances in radio, astronomy and materials study Atomic control of higher frequencies will aid radar, other microwave equipment and television relays This revolutionary instrument is independent of the rotation of the earth on its axis as it revolves round the sun and is unaffected by temperature, pressure and aging The atomic clock will greatly improve astronomical calculations and observations, long-range navigation and communication systems, and systems where atoms serve as electronic components, including radio filters, telephone relays and radar. (*Science News Letter*, January 15, 1949)

BY PRODUCTS OF INDIAN TOBACCO INDUSTRY

Next to the United States, India is the most important tobacco producing country in the world, having an annual output of 879 million pounds Processed tobacco products including pipe tobacco, cigarettes, cigars, chewing tobacco, snuff, and *bidis* have an annual value of 37 crores of rupees

Tobacco leaf required for cigarette manufacture is obtained from the plant after it flowers and bears fruit Tobacco seeds yield 25 to 40 per cent of a greenish yellow oil, solidifying at 25°C and drying on exposure to air It is rich in linoleic acid and contains a fair amount of unsaturated glycerides It resembles soya bean and *til* oils in composition, is classed as a semidrying oil, inferior to linseed oil, and has found use in the preparation of special types of dull paints

Experiments by Rapp and Skinner suggest that tobacco seed oil can be used for edible purposes, provided it is stored at low temperatures and surface exposure favouring oxidation is minimized Its digestibility is 97 per cent compared with 99 1 per cent and 98 2 per cent for cottonseed oil and butterfat respectively Hydrogenated tobacco seed oil is a useful raw material for soap making

Tobacco seed meal constitutes 69 to 75 per cent of the seed content It consists of 26 63 per cent protein, 1 64 per cent oil, 31 41 per cent carbohydrate, 19 9 per cent crude fiber, and 6 59 per cent ash The protein is deficient in lysine Biological value and digestibility coefficient of tobacco seed meal are 51 4 and 78 compared with 78 5 and 98 respectively for skim milk When mixed with lysine the former has a biological value of the same order as that of milk products The rich protein content of the seed makes it a potential raw material for the plastics industry The seed cake is also rich in potash and phosphorus

The Indian tobacco industry annually yields about 100 million pounds of midribs, stalks, and similar waste Utilization of these by-products is under active investigation Promising outlets for tobacco scrap and dust are in manufacturing nicotine and nicotinic acid and conversion to manure by composting or ashing A process for manufacturing a 40 per cent solution of nicotine sulphate in marketable form had been developed in the Ordnance Laboratories, Kanpur Deficiency of nicotinic acid is widespread in India, and as such this vitamin is needed for the treatment of pellagra and for fortifying wheat flour Annual requirements of this acid are computed at 3 million pounds Other constituents of tobacco waste include citric acid, malic acid, pectins, and resins

Tobacco stalks and midribs form valuable potential sources of potash The midribs contain 1 5 to 2.06 per cent of nitrogen and are composted easily. The tobacco ash carries 1 4 to 1 97 per cent of phosphoric pentoxide and 28.81 to 29 75 per cent of potash;

as such it constitutes a valuable manure (*Chemical and Engineering News*, November 29, 1948)

ROY COMMITTEE'S REPORT ON OVERSEAS SCHOLARSHIPS SCHEME

The Committee appointed by the Ministry of Education, Government of India to enquire into the progress and scope of the Overseas Scholarships Scheme (See *Science and Culture 10*, 331, 1945) has recommended that the Scheme should be continued for a period of five years in the first instance

The Committee consisted of Dr B C Roy (*Chairman*), Dr H J Bhabha, Dr B B Dey and Prof N K Siddhanta In its Report which has just been published, the Committee have recommended that the ultimate objective should be to develop the scientific, technical and educational institutions in India to such a level that training for all branches of study, theoretical and practical, would be available within the country Scholars should therefore be sent abroad with a view to manning Indian educational institutions on their return Another important recommendation of the Committee is that Universities, public bodies etc, which participate in the Overseas Scholarships Scheme should bear half of the expenditure on the scholarships allotted to them

In view of the fact that in most cases scholars sent abroad are to become teachers for advanced studies after their return, the Committee feels that scholarships should be awarded only to persons who have proved their ability for research The Committee has also recommended that attempts should be made to place scholars in institutions other than those in English speaking countries, where adequate facilities are available, that the number of overseas scholarships should be progressively reduced and that side by side with the Overseas Scholarships Scheme Government should assist the development of existing technical institutions by grants for equipment, wherever necessary,and by sending teachers abroad for refresher courses It recommends that foreign experts should also be invited for short periods to give lectures etc

Regarding the award of scholarships, the Committee is of the view that merit alone should be the basis for the award of scholarships though preference may be given to educationally backward communities in cases where two or more candidates are available possessing similar qualifications and ability

The Government of India have since then decided to revive the Overseas Scholarships Scheme in a modified form from the coming financial year The modified scheme is largely based on the recommendations of the Roy Committee, which was set up with a view to making recommendations for its improvement

The main objective of the modified Scheme will be to send persons for training abroad in subjects, facilities for which are not available in India, partly to ensure improvement in the standard of instruction and research in the country itself, and partly to meet the needs of the Central and Provincial Governments Only such persons will be sent abroad as can be absorbed in specific undertakings, in operation or planned, on their return

The scope of the scheme has been extended, so as to meet the requirements, not only of Government Departments and of Government sponsored industry, but also of educational institutions like Universities and research and technological institutions The needs of public utility concerns will also be taken into consideration

The choice of scholars for training under the new scheme will be mainly from among persons who have spent some time in a Government organisation, an educational institution or a public utility concern, and who are recommended for selection by their employers On return from abroad they will be expected to serve their parent institutions

The Parliamentary Standing Committee of the Ministry of Education, under the Chairmanship of the Hon'ble Maulana Abul Kalam Azad has since then approved of the new Overseas Scholarship Scheme, a new feature of which will be the adoption of a means test under which the scholar to be sent abroad will be paid a scholarship or subsidy according to his particular levels of income

ENTOMOLOGICAL SOCIETY OF INDIA

The Eleventh Annual General Meeting of the Society was held on January 4, 1949 at the University of Allahabad Dr H S Pruthi, Plant Protection Adviser to the Government of India, Ministry of Agriculture, presided

In the course of his presidential address on the "Need for fundamental research on insects in India", Dr H S Pruthi urged the necessity for establishing a *National Entomological Laboratory* to promote fundamental researches on Insect Morphology, Systematics, Ecology, Physiology, Cytology and Genetics This Laboratory could establish co ordination with universities initiating fundamental work on insects

It is estimated that the damage caused by insects to agriculture in India is more than 10 per cent of the crop yield This ordinarily involves a loss of about 500 crores of rupees per annum and 5 million tons of food crops which is about twice as much as our total imports of food grain to meet the deficit in our food production

Dr Pruthi further stressed the need for researches on industries based on insects *eg*, bee-keeping, silkworm rearing and lac culture

The following were duly elected office bearers of the Society for the year 1949-50

President Dr H S Pruthi (New Delhi), *General Secretary* Dr S Pradhan (New Delhi)

DR P N BHADURI

Dr P N Bhaduri, Lecturer in Botany, Calcutta University, is appointed Cytogeneticist at the Indian Agricultural Research Institute, New Delhi A distinguished cytogeneticist, Dr Bhaduri has developed a new Staining Technique (Feulgen Light Green Method) which attracted attention of cytologists from different parts of the world and this method until now is considered to be the only specific staining method for Nucleoli i e, the small bodies present in nuclei of plant and animal cells

In a series of contributions Dr Bhaduri has established that the number and size relationship of nucleoli in plant cells is a specific character A study of these characters has led to important generalization leading to the establishment of affinities between groups of plants He has further advanced the theory of fragmentation of chromosomes at particular loci as a physical basis of speciation His recent contribution on the mechanism of colchicine action and induction of polyploid plants such as jute and others have received wide attention

Dr Bhaduri rendered conspicuous services as Honorary Secretary, Botanical Society of Bengal, from 1944 48 and was responsible for the issue of a *Bulletin* by the Society, that has earned appreciation both in India and abroad

Dr Bhaduri was a student at the King's College, London (1937 41), where he worked under Prof R Ruggles Gates F R S He was elected a Fellow of the National Institute of Sciences of India in 1944

DR P MAHESHWARI

Prof P Maheshwari, Professor of Botany and Head of the Department of Biology and Dean of the Faculty of Science, Dacca University, Eastern Pakistan, is appointed University Professor and Head of the Department of Botany at the Delhi University A distinguished Angiosperm Embryologist, Prof Maheshwari is known all over the world for his contributions He is the author of an advanced text book on the "Embryology of Angiosperms" (*in the press*) and is editing a book entitled "Manual of Angiosperm Embryology" to be published by the *Chronica Botanica* He has travelled widely in the U S A during his study tour in 1945 47

Earlier in 1936-37, he came under the influence of Tischler at Kiel and Schnarf in Vienna and since then has been responsible for the building up of an active school of embryological researches in India

Dr Maheshwari was elected a Fellow of the National Institute of Sciences of India in 1935 and is the President-elect for the Section of Botany at the Thirty-seventh Indian Science Congress to be held in Poona in January 1950

ANNOUNCEMENTS

Prof P C Mahalanobis, Director, Indian Statistical Institute, Calcutta and Statistical Adviser to the Government of West Bengal, is appointed Honorary Statistical Adviser to the Government of India He will act as the Chairman of the Inter departmental Committee on Statistics which will co ordinate the collection of statistics at the Centre, the Provinces and the States

Prof S R Bose, Professor of Botany, R G Kar Medical College, Calcutta is elected a Vice President of the Section of Mycology and Bacteriology at the Seventh International Botanical Congress to be held at Stockholm in 1950

Sri K Seshagiri Rao has succeeded Sri K Rama Pai, as Controller of Patents and Designs, Government of India Graduating with Honours in Physics from the Madras University, Sri Rao worked as Madras University Research Scholar under Prof C V Raman, at the Indian Association for the Cultivation of Science, Calcutta He published a number of papers on scattering of light in gases and liquids In 1923 he joined the Patent Office as an Examiner of Patents and was responsible for the preparation of a classified abridgement of Patent specifications, according to Industries from 1945 48

Unesco World Review announces its first special supplement which will be entitled "Tribute to Albert Einstein"

The great physicist celebrated his 70th birthday on March 14, and to mark this occasion Unesco prepared a special 30 minute programme consisting of personal tributes by three of the world's most famous scientists The three contributions dealt with three aspects of Einstein's character and work—the man, the scientist, and the seeker of peace These tributes were written by Niels Bohr, Danish physicist and Nobel Prize-winner, Jacques Hadamard, French mathematician and founder member of the League for the Defence of the Rights of Man and Arthur H Compton, one of America's foremost scientists and educators and a Nobel Prize-winner

At the 286th Anniversary meeting of the Royal Society, the following were elected as officers of the Council for the current year

President Sir Robert Robinson, *Treasurer* Sir Thomas Merton, *Secretaries* Sir Edward Salisbury (Biological), Prof D Brunt (Physical), *Foreign Secretary* Prof E D Adrian

Prof Brunt is the Professor of Meteorology at the Imperial College of Science and Technology, London, and succeeds Sir Alfred Egerton, who retires after 10 years of service as *Secretary*.

Dr H G Biswas, Director, Sir Prafulla Chandra Research Laboratory, Bengal Chemical and Pharmaceutical Works Ltd, Calcutta, has returned from his tour in Europe where he visited many leading chemical factories in England, Germany and Switzerland and arranged for import of plants and machineries for chemical industries He also worked on the chemical constitution of Andrographolid, the active principle of *Kalmegh* in Prof Karrer's Laboratory at Switzerland

Sri Sasanka Sekhar Sircar, Anthropologist, Department of Anthropology, Government of India, is admitted to the degree of doctor of science of the Calcutta University, for his thesis entitled "Studies on Twins" The thesis was adjudicated by a Board of Examiners consisting of Prof R Ruggles Gates, F R S, Prof L S Penrose, and Prof W Le Gros Clark, F R S The investigations were carried out at the Bose Research Institute, Calcutta

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BOOK REVIEWS

Heredity—By A Franklin Shull McGraw Hill Book Company, Inc, 4th Edition, Price $ 4 00

The study of heredity is now acclaimed as one of the most important branches of higher biology Heredity in its practical aspects was known to the early eighteenth century hybridists But the credit of knitting together these fragments of knowledge into a scientific whole goes to Gregor Mendel The socio logical side of the heredity problem was ushered in by Sir Francis Galton in the form of Eugenics

The book under review deals with the various aspects of heredity in 26 chapters, followed by an appendix on quantitative characters In the first chapter the author traces the historical development of heredity to its modern status The 2nd and 3rd chapters deal with cells, cell division and the various important modes of reproduction—vegetative, sexual and asexual The role of genes—those mystical ultrasmall proteinous substances, as the carrier of hereditary characters is described in three subsequent chapters The chapter on Back cross and Test cross, though somewhat brief, is highly stimulating The sex dependence of various characters, multiple alleles, interaction of genes etc are described in chapters 8-16 In the chapter on Heredity and Evolution the author seems to have skipped over the possible effect of cosmic rays on living cells (including chromosomes) in bringing about mutation of species In this and several previous chapters the author has freely drawn from the historical Drosophila experiments

The remaining 7 chapters deal exclusively with the human side of the heredity question The facts about the Rh factor in blood are well described The bearing of hereditary influence on mental life has been properly stressed To quote the author "On the credit side of the genetic ledger no item is of more importance than intelligence" It amuses one to learn that such an abstract subject as mathematics is a family accomplishment and that the Bernoulli family included at least eight important mathematicians

Eugenics, as a possible method of making better human society, is described at some length The socio political aspects of heredity have been described concisely in the two concluding chapters Author's suggestion that the immigration policy of the U S A should be based on genetic constitution, rather than nationality, will be heartily welcome to all prospective immigrants to the Dollar land

The insertion of 233 problems variously distributed at the end of the different chapters will be highly useful to students of applied genetics The value of the book is all the more enhanced by an appendix defining and illustrating some statistical concepts most commonly used in this branch of biology The get up, printing, and diagrams are in keeping with the tradition of the publishers

R D

Library and Preservation—By M N Basu To be had of The Book Company Ltd, Calcutta, 1948 Pp 1 44, Price Rs 2/

This is a pamphlet written by an experienced hand dealing with methods of organization and preservation of books, manuscripts, etc Greater stress is laid on the latter and thus the pamphlet—specially dealing with the new indigenous devices prepared by the author—is an indispensable one for all libraries through-

out India The subject of preservation of book on scientific basis has not so far attracted the attention of all concerned and it is to be hoped that the diploma course in librarianship in the Indian Universities should cover this aspect of library organization as an independent course of study

A K G

Lighting Design—By Parry Moon and Domina Eberle Spencer Approx 500 pp 100 illustrations, 6"×9" stiff cloth binding Addison Wesley Press Inc Kendall Square, Cambridge 42, Mass, U S A $ 5 00

The foundations for lighting calculations were first laid by Lambert in his classic treatise, "Photometria Sive de mensura et grandibus luminis, colorum et umbræ", 1760 Unfortunately he failed to realise any relationship between this radiant energy and the law of physics This book very clearly shows the modern conception of light in the form of electromagnetic radiation, a fact which is even today shrouded by the traditional over emphasis given to candle power and its ancillory physical terminology That the physics of radiant energy should be the logical starting point for any study of lighting design, has been fully recognised and developed in this text For this reason alone, it stands as an outstanding work in the field of illumination engineering and a guide to the lighting principles of the future

The book comprises of eleven chapters, and four appendices, together with exhaustive bibliographies and tables with each chapter In accordance with modern electrical engineering practice, the meter kilogram second system has been employed throughout, instead of the lumen No difficulty however is felt due to this change as a comparison of the various concepts and units is fully dealt with in Appendix B The first two chapters deal with the sources of illumination and the physical fundamentals of radiation necessary for evaluating the photometric quantities Interesting accounts of the various types of lamps and luminaries are given with their historical back ground such as the development of sodium-vapor and high pressure mercury lamps in Holland, the cold cathode lamp etc The source of illumination is split up into three categories, *viz* incandescent, electric discharge, (sodium neon and mercury vapor) and fluorescent lamps, and their characteristics brought out In addition to the source of illumination, the reflecting surfaces and transmitting media play an important part in the design of lighting of rooms This phase is dealt with in Chapter 3, where the concepts of spectral and total reflectance, and total transmittance are discussed and ideas, of perfectly specular and perfectly diffusing surfaces are introduced

That energy can be transmitted by electromagnetic waves is familiar to many, the most common example being the heating effect of sunlight When this radiation strikes a surface, some of the energy is transformed into thermal form, and causes a rise in temperature The temperature rise is thus a measure of radiant power per unit area of the surface and is termed radiant pharosage, employing a unit of watts per square meter The methods of calculating pharosage are discussed in Chapters 4 to 6 Included in them is a digress on another important topic, *viz* helios, the helios at a given point and in a given direction being defined as a quantity equal to π times the incident pharosage at that particular point, per unit solid angle The unit of this concept is blondel, named after Andre Blondel who carried out some pioneering work in photometrics

The methods of determining pharosage are extended in Chapter 7 to include the actual practical cases where depreciation occurs due to (*i*) internal blackening of the lamp, (*ii*) effect of dust collection on lamps and (*iii*) effect of chemical change in colour of walls or change due to collection of dirt or dust The importance of psychological factors in lighting and illumination is revealed in Chapter 8, wherein a detailed discussion on the geometry of uniform and non uniform visual fields is given, together with their relationship with various photometric units The engineering principles underlying human vision are interestingly described and it is shown that the eye is capable of adapting to a very wide range of helios values from 1,000,000 to 1, *i e* from white surfaces in direct sunlight to threshold values, mainly as a result of the photochemical process in the retina

A correctly lighted room must satisfy a number of requirements if it is to allow best possible vision with a minimum of fatigue The illumination engineer therefore requires a set of definite criteria against which he can check his design A set of such conditions were first proposed in 1936 by the senior author (Parry Moon, "Scientific Basis of Illuminating Engineering," McGraw Hill, N Y 1936), and enumerated again in an improved form in this text in Chapter 9 These factors are pharosage, helios distribution, specular reflection, shadows, spectral distribution, psychological effect, aesthetic effect and economics These factors cover the entire known range for good design and when correlated together as in the Chapter 10, result in a highly scientific method of lighting rooms The question of colour is taken up in the last chapter By means of exacting scientific discussion colour is specified under two systems *viz* (*i*) trichromatic weighing functions, first internationally standardized in 1931, by Commission Internationale de L'Eclairage, and now known as the C I E system, and (*ii*) Munsell system, originated by a Boston artist A H Munsell In both these systems a colour is represented by a point in a three-space configuration and specified by the radiation it emits Useful practical suggestions for their adoption are given

The value of the whole work could have been further enhanced by incorporating a chapter or two containing the principles of polarized lighting of highways and their effects on traffic, as illuminating engineers are often called upon to design and layout road

lights Several terms not normally met with in the literature on the subject have been used in the text Though their definitions are given in their respective chapters and the various symbols used, collected and given in Appendix A, the reviewer feels that a glossary of terms should have been included in an additional appendix, thereby forming a very quick and easy source of reference to the point involved

In spite of these small drawbacks, this publication with its clear expressions, copious tables and references, and the presentation of a new and logical method of lighting design to provide the best possible vision with a minimum of eyestrain, forms a worthy addition to the literature on illumination engineering Presented in the form of mimeographed notes which have been used for several years in the Mass Inst of Techn and Brown University, this book can be profitably read by anyone having a grounding in physics, engineering and elementary calculus

S K G

Vernalization and Photoperiodism—A Symposium—By A E Murneek and R O Whyte *et al Lotsya*, (vol 1) a Biological Miscellany, edited by F Verdoorn, Sup Oct, ca 220 p, illustrated Published by the Chronica Botanica Co, Waltham Mass, U S A, Macmillan & Co Ltd, Calcutta, Bombay, Madras, 1948 Price $ 4 50

The above symposium is a timely publication and deals with various aspects of Vernalization and Photo periodism, as have emerged from recent contribution in this expanding field of Plant Physiological research The original conception of vernalization which was based on the experience of freezing effect in winter cereals in producing a stage leading to flowering was known long ago and the idea was included in Gassners "bluhreife" stage in plants But the far reaching practical results claimed to have been obtained in U S S R by Lysenko and his co workers and the growth of the idea of Phasic development given out by this group of Russian investi gators, have attracted attention of various workers in different parts of the world, with the result that the original idea has undergone a marked modification Not only the practical aspects have been stressed, but attempts have been made to fit in the results to develop a theory of New Genetics apart from the well established one, and inspired the idea of dialectic materialism raising a world wide controversy The symposium is free from this controversy, and also contains no contribution from workers in U S S R where this aspect of study has found the most favoured recognition The failure of many workers to obtain uniform results on pre sowing temperature effect in different parts of the world, has led to the study of post-sowing environmental factors, especially the light factor and photoperiods So later investigations have brought two quite independently developed lines of researches, *viz*, Thermal effect (vernalization) and Photoperiodism together to explain the initiation of reproductive stage in plants

The symposium under review contains valuable articles on the development of this synthesis and many salient points have been brought into prominence Though the whole aspect of this problem of investigation into the intricate process—possibly physio-biochemical in nature leading to flowering in plants, is still in a very fluid and elementary stage and no connected step by step development of our knowledge is yet possible, nor obtainable, yet the different contri butions from different workers in their own lines of investigations, have brought within a single volume the various aspects of our problem The symposium deals with historical sketches on vernalization and photoperiodism and is followed by 10 chapters on various aspects *viz*, role of hormones, effect of wave lengths of light, nutritional and histological changes, photo periodism in past flora, investigations on tropical crops, and thermoperiodicity Many of these articles contain results of well known previous publications and are in the nature of a descriptive analysis from which much valuable information on the different aspects can be gathered The importance of thermoperiodicity in such investigations has been brought into prominence and this factor must be taken into consideration for arriving at any conclusion An important supple ment has been added to the symposium from some of the German workers This school has tried to tackle the problem from the point of view of the inherent rhythmic changes taking place inside the cell Such contributions are really welcome from that great country and especially after the last World War The endogenic rhythmicity is a well known characteristic of a living cell as shown by growth movements and the scheme presented by Bunning that the working of photoperiodic stimulus (alteration of light period with dark period) is dependent and is directly correlated with the state of endogenic rythmic changes taking place at the time of reaction, is no doubt a novel attempt to seek an ex planation in another direction, not yet taken into consideration The differential behaviour of short and long day plants has been traced back to the same basis and some of the anomalous behaviour of these two types of plants have been explained Further study on Tropi cal Crops and the chemical changes preceding, accompanying or following during the rhythmic stimulation would furnish more material Another chapter has been added on the Genetics of Photoperiodism where an attempt has been made to give genetical basis on the behaviours of winter and summer annuals and between the long and short day plants on one side with that of neutral day plants on the other side

The symposium is a valuable contribution in the field of developmental physiology, and gives under well defined headings an up-to-date accumulation of data on advancements made in our present knowledge, and fields for further research The *Lotsya* publishers are to be congratulated for this volume with nice get up and interesting reading. It will be indispensable for workers in the field and for advanced students

B K. K.

Engineering Metallurgy—by W. E. Woodward, M A (Cantab) Constable & Co, Ltd, 10 Orange Street, London W C 2, Demy 8 vo pp x+176, 1948 Price 15 sh net

To survey a subject like engineering metallurgy in just 160 pages is a very difficult task and one which evidently leaves much to be desired. In this slim volume, the author has tried to include a variety of topics on engineering metallurgy, with the pan of the balance tilting more on metallurgy than on engineering The subjects covered include the manufacture of iron, steel, non ferrous metals and their alloys, micro structure, constitution diagrams, heat treatment, and castings In addition, there are topics on welding bearing metals, mechanical testing and pyrometry When it is known that the modern treatment of ferrous and non-ferrous metallurgy is individually treated in voluminous texts comprising of hundreds of pages, (R J Anderson's, "The Metallurgy of Aluminium and Aluminium Alloys" 913 pp A C Baird & Co Inc U S A H M Boylston's "Introduction to the Metallurgy of Iron & Steel," 563 pp Wiley), it can be realised that the book under review is grossly inadequate to do full justice to the subject chosen by the author However, as stated in the preface, the aim of this work is to introduce the "trade names" of the various metallic alloys to the engineers and to familiarise the profession thereby The book however fulfils more than this, for it gives to an engineering student the basic elements of metallurgy and vividly brings to light the underlying principles inherent in the fabrication processes of welding and flame cutting

The arrangement of the chapters appear illogical, as, the trend of continuous thought is nowhere main tained but broken up by introducing subjects at odd places Thus welding is treated in chapter 13 and pyrometry left over in the last chapter A reorienta tion would have been more desirable Similarly "Die Casting" should have come immediately after iron and steel castings or atleast immediately after the chapter on aluminium and magnesium alloys A glossary of technical terms, neat diagrams and good microstructure photographs of typical ferrous and non ferrous structure form the highlights of this text The absence of a bibliography however detracts its worth The gulf between engineering and metallurgy could have been more effectivley bridged by omitting some and enlarging other chapters to produce a work somewhat akin to A C Vivian's "Essential Metal lurgy for Engineers", (Pitman), or R Fox's, "Ferrous Materials for the Engineer" (Griffin) As an elementary guide for engineering students preparing for metallurgy it will be of good help, though it is doubtful as to what extent it will serve the practising or designing engineer, as claimed in the book A metallurgist, however, will find this work of little use in picking up the shreds of engineering and acquainting himself with that subject

S K G

The Wealth of India—*A Dictionary of Indian Raw Materials and Industrial Products* (1) *Raw Materials, Vol I (A B)*, Price Rs 15/- Pp xxvii + 253 with 39 plates (32 monocolour and 7 multi-colour), printed on Art Paper, bound in rexine, size 11"×8" (2)*Industrial Products, Part I (A B)*, Price Rs 8/ Pp xii + 182 with 8 plates (monocolour), printed on map litho paper, bound in cloth, size 11" ×8½" Published by the Council of Scientific and Industrial Research, Department of Scien-tific Research, Government of India, with a fore-ward by Hon'ble Pandit Jawaharlal Nehru

More than 50 years have elapsed since Watt com pleted his monumental work on the *Economic Products of India* (1889 99) *in six volumes The Commercial Products of India*, which is a brief summary of Watt's bigger work, appeared in 1908 The period since the publication of Watt's works has been one of rapid chan-ges, and a volume of scientific data has accumulated but scattered in various publications not easily acces-sible to the common man

World Wars I and II has given an impetus to India's indigenous industries and correct estimation of na-tural resources and industrial potentialities are a neces-sary requirement for India today

A planned presentation of all available data, scien tific and economic, was thus considered overdue and hence the Council of Scientific and Industrial Research in 1942 undertook the task of revising Watt's work and compiling a new critical compendium of data rela-ting to the present and potential wealth of the country The book under review thus seeks to bring Watt up-to date, incorporating fresh data that has since been discovered There is also an attempt to remove the outstanding defect in Watt's by a critical analy sis of the data presented in the volume Otherwise it has hardly replaced most of the facts outlined by Watt

Volume I of Raw Materials contains about 240 articles, 91 per cent of these deal with botanical, 6 per cent mineral and 3 per cent animal products Sta-tistical information are given in tables wherever pos-sible

A striking omission in this volume is a note on *Agaricus* which includes the common edible mushrooms

Part I of Industrial Products contains about 40 articles and these will be very useful to the industria-lists In the book sent to us for review pages 97-104 are missing

Some of the sketches fail to serve their purpose *e g*, the plate of *Acalypha indica* is not impressive

There are also mistakes in nomenclature *e g*, *Acacia sundra* in p 20 should be *A chundra*

By the way, in spite of long *errata* lists, there are mistakes *e g*, on page 178, column 2, *flowors* should read *flowers*

It is planned to complete the Dictionary in 6 volumes covering 4,000 topics, the first volume of which has been published after 7 years of labour containing only 280 topics Calculated at this rate, we are afraid, the remaining five volumes are not likely to be published in the near future This is indeed distressing when it is noted that it took Watt 15 years to publish his 6 volumes, each containing on an average 900 pages and working almost single handed

A long list of the staff engaged in compiling the Dictionary cited in p viii of Vol I, points to the obvious fact that this unusual delay in compiling the work is due to a continually changing personnel which has also resulted in a lack of uniformity of presentation of the subjects dealt with

It is curious to find that although 90 per cent of the contents would deal with plants only, the office of the Dictionary was not centred at the Botanical Survey of India's offices at the Indian Museum, Calcutta where Watt compiled his work and where perhaps greater facilities for expeditious work were available A system of 'ledger' opened anew at Delhi, was already in existence at Calcutta though 'dead' (See *Science and Culture, 11*, 109, 1945), and revival of these would have saved considerable time and money

The book is likely to be useful to the industrialists, the economist, the administrators and the lay public

A K G
J K S

Suggestions for Science Teachers in Devastated Countries—By J P Stephenson Published by the United Nations Educational, Scientific and Cultural Organization, Unesco House, 19 Avenue Klaber, Paris 16, 1948

Publication of an illustrated booklet, as an aid for science teachers in war torn areas by the Unesco shows how teachers lacking elementary scientific equipment can make apparatus from simple, every day materials The booklet is distributed free by Unesco to schools in Greece, Poland, Czechoslovakia, Austria, Hungary, Italy, China and the Phillippines

The author is a science master at City of London School and member of the Royal Society Committee for Co operation with Unesco He first explains how science teaching can be commenced without the use of apparatus and then shows how equipment for experiments in astronomy, meteorology, measurement, heat, light, magnetism, electricity, chemistry and biology can be improvised from materials such as wood, glass tube, wire, nails, bottles and other household articles

The booklet also touches on the use of visual aids in science teaching and includes a description of recent laboratory materials, such as plastics and alloys, as well as a section on laboratory receipts, charts and logarithm tables Suggestions are made clear by well-drawn diagrams

"These improvisations should not be thought of as makeshifts," the author says in a foreword "They, and the exercise of constructing them, are in the best tradition of science and science teaching All the great scientists have used such apparatus and many have made their greatest discoveries in this way"

Unesco hopes that teachers in devastated countries will find the book helpful, not only for the concrete suggestions it offers, but also for the stimulus it gives for further improvisation in elementary science It is possible, too, that teachers in more fortunate countries may derive useful ideas for extending the scope of their classes at little cost

Extracts from the booklet in English or in translation may be reproduced with proper acknowledgements to Unesco

A G

Working with Plastics—By Arthur Dunham, M Ed, McGraw Hill Book Company, Inc, New York Pp 22›, $3 50

This book deals with the subject of plastics for the technical students It is divided into eight chapters, the first one describing general information concerning plastics and others deal mainly with the workshop operations with different types of plastics, *e g*, phenolic plastics, acrylic plastics etc The suggestions are practical throughout, the methods are based on practical experience of the author The book is amply illustrated showing how various useful and dainty articles can be made with plastics and the tools and equipment needed for working with it The book has a helpful glossary for non technical men who will like to master plastic craft This can highly be recommended as a practical hand book on plastics as a craft material

R C.

LETTERS TO THE EDITOR

[The Editors are not responsible for the views expressed in the letters]

CORRECT NAME OF *PLECTRANTHUS INCANUS* LINK

Two names, *i e*, *Plectranthus incanus* and *Plectranthus cordifolius*, have been widely used in literature to designate a species of Indian *Labiatae* This plant is widely distributed on the sub continent of India, and has been collected from the Western Himalayas to South India, and from Bombay to Assam The late Sir Joseph Banks, who was greatly interested in the introduction of horticultural and other economic plants in England, obtained seeds of this plant about the year 1781 from Koenig from South India Later, this plant was also raised in Kew and the plant was described by Aiton in 1789 under the name *Ocymum molle* Subsequently, this plant drew the attention of a number of botanists who gave several other new names According to the rules of nomenclature, Aiton's name being the earliest, should be the basis of a new combination under *Plectranthus* The correct and legitimate name should therefore be *Plectranthus mollis*, and all other names should be considered as synonyms It is desirable that in future this name should be used in the Indian Herbaria material The synonymy is as follows

Plectranthus mollis (Aiton) *Sprengel*, Syst Veg *2*, 690 (1825)

- *Ocymum molle* Aiton, Hort Kew, *2*, 322 (1789)
- *Ocymum mayporense* Roth, Nov Pl Sp 271 (1821)
- *Plectranthus incanus* Link, Enum Pl Hort Berol *2*, 120 (1822), Hook f, Fl Br Ind *4*, 621 (1885), Prain, Beng Pl 846 (1903),
- *Plectranthus divaricatus* Weinm in Syll Pl Nov Ratisb *1*, 68 (1824)
- *Plectranthus cordifolius* D Don, Prod Fl Nep 116 (1825), Wall Pl As Rar *2*, 16 (1831), Benth in DC Prod *12*, 66 (1848)
- *Plectranthus maypurensis* Sprengel, Syst Veg *2*, 691 (1825)
- *Plectranthus secundus* Roxb Fl Ind *3*, 20 (1832)

A good description of this plant is available in the recent monograph on Indian *Labiatae*[1] Unfortunately in this work, the author has adopted the more popular name of *Plectranthus incanus*, and as such, the present note is justifiable In the same place (*l c*) the name *Ocimum mayporense* Roth, has been stated to occur in Rheede's *Hortus Malabaricus 10*, tab 84 (1690) Surely, this is an error, as Rheede published the above plate under the name *Perim tolassi*

Royal Botanic Gardens, Kew D CHATTERJEE
18 9 1948

1 *Rec. Bot Surv Ind 14*, No 1, 47, 1940

NOTE ON HIGH VOLTAGE OSCILLATION CHARACTERISTICS OF HARTLEY CIRCUIT

It has been shown elsewhere[1] that there is a general agreement between the oscillation characteristics of the Hartley Oscillator drawn by two methods, *i e*, directly and from the static curves of the valve It was noted that there appears to be slight departure when high voltage is used The point is further pursued in the present communication using the still higher voltage *i e*, $V_0 = 140$ Volts

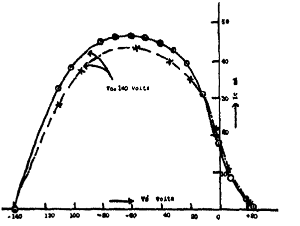

Fig 1.

The full curve represents the oscillation characteristics of the Hartley circuit drawn by direct method and the dotted curve shows the same as calculated from the static curves of the valve In this case also the general agreement of shape is preserved with the slight departure between the two curves

As a point of difference, it is to be noted that the sharp maxima at the top of the oscillation characteristics for lower voltage is replaced by the more flat top in the present case

V L Taiekar

Department of Physics,
Dungar College,
Bikaner, 26 10 1948

[1] Talekar, V L *Curr Sci* 16, 308, 1947

EFFICIENCY OF USED DIESEL ENGINES

According to standard specifications, new Diesel Oil Engines have the best efficiency at a load ranging generally between 75 to 100 per cent of rated full load A brake thermal efficiency of 30 per cent is considered an average figure An examination was conducted into performance of used Diesels, and some interesting observations were noted The engine under review yielded a maximum brake thermal efficiency of about 28 per cent This test was not sufficiently indicative, as will be seen presently Efficiency at different loads was also determined It was found in this case, that the best efficiency is found at a limit of 44 to 62 5 per cent of the rated full load Beyond 62 5 per cent, the efficiency falls, and presently the engine begins to smoke That is, the engine behaves as an overload beyond 62 5 instead of full rated load This difference of 37 5 per cent represents the power loss of the engine, and is a measure of its depreciation This test figure is a substantial description of the used engine Comparing this figure with brake thermal efficiency, this loss in output seems to be an easy guide in estimating depreciation or quality of maintenance The actual experiments are described below

Engine Description—B H P—115, Cycle—4 stroke, Cylinders—3, R P M—500, Cold starting and self lubricating Directly coupled to alternator

Service history —about 13 years at 18 hours daily under smooth load conditions No major repairs or replacements effected in its life

Tests —Observations were taken under actual service conditions Oil consumption was noted against loads Duration of each trial —minimum two hours but generally 6 hours Load fluctuations $\pm$ 7 B H P Limiting loads were specially checked over short runs Selected readings out of 1000 hours run recorded There were no change of fuel or lubricant, no repairs other than routine ones, and no replacements, during trial

Results—Max efficiency (brake) at 44 to 62 5 per cent of rated full load

The above test data are not to be treated as of an ideal engine

The same experiments were simultaneously conducted on a second Diesel Oil Engine having same specifications and age, and similar service and attendance Results obtained in this case is a maximum efficiency of a little over 28 per cent at 45 to 65 per cent of rated full load (new) The figures in both the cases are, as it should be, more or less same

A practical import of the findings seems that for oil economy, the depreciated load capacity rather than rated full load should be the limit Secondly, it seems to the author that mapping of a standard of the above load or power loss of each engine would provide a very easy means to check quality of maintenance of an engine, and for comparing service behaviour of different engines In this line, working of a third engine was enquired into, and briefly observed In this case only 12 years service accounted for the loss of 50 per cent in output This is supported by more rigorous service of and poorer attention on this engine

My thanks are due to Messrs M K Ghosh for all facilities offered for experiments in their power house

Prafulla Chandra Ghosh

78A Manoharpukar Road,
Calcutta, 26-11 1948

FODDER VALUE OF *SETARIA PALMAEFOLIA* STAPF

Setaria palmaefolia Stapf grows abundantly in Assam and is reported to be greatly relished by the cattle Observations on this grass undertaken by this Division since last season are presented here

Seeds (half pound) of this grass were obtained from the Superintendent, Lagden Memorial Farm, Halem, Assam, and sown on August 13, 1947 after due preparation of the soil in a 0 25 acre plot in the sewage area of the Division and irrigated on August 17, 1947 The germination was very good The crop was further irrigated on September 27, 1947 and again on October 25, 1947 The growth was luxuriant, particularly so under shade, and the whole area was covered The grass showed a comparatively longer vegetative period than other grasses under observation and flowered in the first week of December The grass, however, was found to be susceptible to frost A slight frost in the middle of December 1947, affected the top growth, the bottom shoots, however, escaped Although the plant was found to set abundant quantity of seed, owing to frost only 2 lbs of seeds could be secured The plants remained dormant during January and February and the spring growth was observed in the first week of March

As the crop was damaged by frost, observations on yield of green fodder could not be taken Subsequent cutting in February, in rather semi green condition, (the bottom shoots still remained green and were protected by the top growth) gave an out-turn of approximately 175 maunds per acre The grass was very greedily consumed by the work animals, showing that it was highly palatable even at this late stage

Chemical analysis in pre flowering and flowering stages was carried out in the Chemistry Division of the Institute by M A Idnani and R K Chhiber The results of these analyses along with the chemical composition of some of the important exotic and indigenous grasses are given below for comparison

TABLE SHOWING THE CHEMICAL COMPOSITION OF *Setaria palmaefolia* AND SOME OTHER IMPORTANT INDIGENOUS AND EXOTIC GRASSES

Name of the grass	Stage of analysis	Crude protein	Crude fibre	Ether Extract	Nitrogen free extract	Sol ash	Sand & silica	Ratio of protein to carbo hydrate
Setaria palmaefolia	pre flowering	16 61	26 91	4 33	38 53	8 57	5 03	1:2
–do–	flowering	10 07	30 98	2 13	42 10	7 31	7 44	1 4
**Pennisetum cenchroides*	prime pre flowering	6 24	34 43	1 47	44 55	6 45	6 86	1 7
**Cynodon dactylon*	,,	10 04	31 89	1 82	44 00	5 69	6 96	1 4
* –do–	ripe (flowered)	4 90	39 74	1 50	46 07	2 27	5 52	1 9
**Pennisetum purpureum* (Napier)	Not mentioned	6 16	28 07	2 26	47 47	10 16	5 88	1 8
**Panicum maximum* (Guinea)	–do–	5 22	36 38	1 55	44 70	—	—	1 9
*Perennial Rye grass (*Lolium perene*)	–do–	11 28	25 19	4 89	49 62	9 02	—	1 4
†Timothy (*Phleum pratense*)	pre flowering	10 33	30 17	2 89	49 59	7 72	—	1 5
† –do–	flowering	8 41	32 40	2 80	50 16	6 23	—	1,6
†*Poa pratensis* (Blue grass) (Kentucky)	pre flowering	22 58	21 37	5 24	39 52	11 29	—	1 2
–do–	flowering	13 46	29 95	3 57	42 86	10 16	—	1,3

* Ref K. C Sen 1946 I C A R Misc Bull No 25, pp 10

† Morrison, F B . Feeds and Feeding, pp 966 and 972 (reduced on moisture free basis)

The grass is unusually rich in protein content in both pre flowering and flowering stages and surpasses all the known indigenous grasses and compares very favourably in this regard with such important grasses as perennial rye grass, timothy and bluestem kentucky of the West The ratio of crude protein to carbohydrate in the pre-flowering stage is roughly 1 2, which is considered to be excellent for feeding dairy animals The mineral content is also fairly high Another interesting point is that the grass shows much less fibre content in both stages, thus making it very palatable to the stock

Its leafy habit, capacity to tolerate shade, high production of viable seeds, high yielding capacity, its high protein content at both stages and the ratio of crude protein to carbohydrate,—all indicate that the grass is very suitable as a pasture or hay grass Its only drawback is its susceptibility to frost Its capacity to tolerate shade is also a desirable character and can be utilized in the improvement of natural grasslands by re seeding them Further investigations are in progress

We are indebted to Dr J N Mukherjee, Director, Indian Agricultural Research Institute, for his valuable suggestions during the conduct of this investigation

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ON THE CONSTRUCTION OF HADAMARD MATRICES

An orthogonal matrix X with elements $+1, -1$ affords a weighing design (chemical balance problem) of maximum efficiency[1, 2]. These orthogonal matrices are useful also in multifactorial experiments[3]. When X is a square matrix the value of the determinant of X is $N^{\frac{1}{2}N}$. Hadamard[4] has proved that when the elements of a square matrix are restricted to lie in the range $(-1, +1)$, the maximum value $N^{\frac{1}{2}N}$ of the determinant of X is achieved when the elements are either $+1$ or -1 and the matrix is orthogonal. It is this property[2] that lends maximum efficiency to a weighing design with an orthogonal matrix. It is known that the necessary condition for the existence of a Hadamard matrix H_N is

$$N \equiv 0 (\text{mod } 4)$$

with the exception of $N=2$. It is not known however whether the above condition is sufficient or not. Plackett and Burman[3] have constructed all Hadamard matrices of order $\leqslant 100$ except 92.

Hadamard matrices are associated with symmetrical balanced incomplete block designs and afford solutions for designs[5] given by

$$(1) \qquad b = v = 4\lambda+3, \; r-k = 2\lambda+1,$$

as also for their complementary designs. If all the elements in the first row and column of a Hadamard matrix are converted to $+1$ changing when necessary the signs of all the elements in the corresponding column and row and if the first row be subtracted from all the remaining rows, the distribution of 0 as also that of -2 in the resultant scheme without the first row and the first column, affords the arrangements for balanced incomplete block designs. The distribution of -2 gives the complementary design to that given by the distribution of 0. Similarly given an arrangement of the balanced incomplete block design of the above type, $+1$ may be put for the occurrence of a variety and -1 for the non occurrence, the arrangement so formed may then be bordered in the first row and first column with plus ones and the resultant scheme will be a Hadamard matrix.

Bose's method[5] for the construction of symmetrical balanced incomplete block designs could be used for the construction of Hadamard matrices of a certain class. There is however a close connection between the method outlined by Plackett and Burman[3] for the construction of Hadamard matrices and the method used by Bose[5] in the construction of symmetrical designs.

1. *Method of Plackett and Burman* : In the construction of Hadamard matrices, Plackett and Burman have defined Legendre function (a) such that

$$\chi(0) = 0$$

$\chi(a) = +1$, when a is a quadratic residue in GF (p^n)

$\chi(a) = -1$, when a is a non quadratic residue in GF (p^n)

They have made use of the fact that the numbers of quadratic residues and non-quadratic residues in GF (p^n) are equal $(p>2)$ and have subsequently proved some theorems leading to the construction of Hadamard matrices. The working principle is reproduced below.

(*i*) Consider the matrix $A = (a_{ij})$ $(i,j=0,1, \ldots p)$ of order $(p+1)$, where $P=4t-1$

$$a_{i0} = a_{0j} = +1,$$

$$a_{ij} = \chi(j-i) (i\neq 0, j\neq 0, i=j)$$

Then the matrix A is orthogonal.

(*ii*) To construct A of order $p^n + 1 = 4t$, the rows and columns (except the first) are associated with the elements of GF (p^n) and the method is the same as above.

(*iii*) If A is orthogonal, $\begin{bmatrix} A & A \\ A & -A \end{bmatrix}$ is also orthogonal and has double the order of A.

(*iv*) If $p^n = 4t + 1$ and $(p^n + 1)$ is not divisible by 4, an A of order $2(p^n + 1)$ can also be obtained.

Consider the matrix $B = (b_{ij})$ $(i, j = 0, 1, 2, \ldots p^n)$ of order $(p^n + 1)$, $[p^n = 4t + 1]$

$$b_{i0} = b_{0j} = +1$$

$$b_{ij} = \chi(u_j - u_i), \; (i \neq 0, j \neq 0),$$

where u_i is the element of GF (p^n) associated with the $(i + 1)$th row and column of B, $i = 1, 2, \ldots p^n$

$$b_{00} = 0$$

Then B is orthogonal. Now replace

$$+1 \text{ by the matrix } C = \begin{bmatrix} 1 & 1 \\ 1 & -1 \end{bmatrix}$$

$$-1 \qquad -C = \begin{bmatrix} -1 & -1 \\ -1 & 1 \end{bmatrix}$$

$$0 \qquad D = \begin{bmatrix} 1 & -1 \\ -1 & -1 \end{bmatrix}$$

The resulting matrix is also orthogonal and is of the type required.

It will be noticed that the methods under (*i*) and (*ii*) are identical, while matrices under (*iii*) are obtainable by doubling the matrices given by (*i*) and (*ii*). Method (*iv*) is different.

2. *Bose's method of constructing symmetrical Balanced Incomplete Block design* : Bose has shown that a solution for the design (1) is always possible when

$4\lambda + 3$ is prime or a power of a prime. The initial block consists of the elements

$$(X^0, X^2, X^4, \ldots X^{4\lambda}),$$

and the remaining blocks are obtained by adding to it all the non zero elements of GF (p^n)

It has been mentioned before that in developing the arrangement of a balanced incomplete block design to a Hadamard matrix, $+1$ is associated with the occurrence of a variety and -1 with the non occurrence Therefore $+1$ will take the place of the varieties corresponding to the above elements in the initial block The above elements are all quadratic residues and therefore $\chi(x^0)$, $\chi(x^2)$ $\ldots$ $\chi(x^{4\lambda})$ will all be $+1$ The initial block in Bose's method will therefore be the same as that row of (a_{ij}), which corresponds to the 0 element of GF(p^n) Bose's method is therefore identical with the approach made by Plackett and Burman in respect of methods (i) and (ii)

Hadamard matrices of order 2^{N+1} described by Plackett and Burman as geometrical designs because of their connection with finite geometries, can be obtained from Bose's N dimensional geometrical designs (P_N^{N-1}), for which $S=2$ The parameters will take the following values —

$$b = v = 2^{N+1} - 1,\ r = K = 2^N - 1,\ \lambda = 2^{N-1}$$

3 *Method (IV) of Plackett and Burman* Bose has given the general solution for $v = 4^\lambda + 3 = p^n$ The method(*IV*) of Plackett and Burman can be utilised for finding the general solution of symmetrical designs for $v=4\lambda+3 = 2p^n+1$.

The orthogonal matrix B of order p^n+1, $(p^n=4t+1)$ is particularly useful in weighing designs

Putting $p^n = 3^2$, an orthogonal matrix of order 10 has been constructed and is shown below

$$(2)\quad \left|\begin{array}{rrrrrrrrrr}
0 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \\
1 & 0 & 1 & -1 & 1 & -1 & 1 & -1 & 1 & -1 \\
1 & 1 & 0 & 1 & -1 & 1 & 1 & -1 & -1 & -1 \\
1 & -1 & 1 & 0 & -1 & 1 & -1 & -1 & 1 & 1 \\
1 & 1 & -1 & -1 & 0 & 1 & -1 & 1 & 1 & 1 \\
1 & -1 & 1 & 1 & 1 & 0 & -1 & 1 & -1 & -1 \\
1 & 1 & 1 & -1 & -1 & -1 & 0 & 1 & -1 & 1 \\
1 & -1 & -1 & -1 & 1 & 1 & 1 & 0 & -1 & 1 \\
1 & 1 & -1 & 1 & 1 & -1 & -1 & -1 & 0 & 1 \\
1 & -1 & -1 & 1 & -1 & -1 & 1 & 1 & 1 & 0
\end{array}\right|$$

If 10 weighings are required to be made for 10 objects to be weighed, (2) is perhaps the best design The variance factors are equal to 1/9 If 10 weighings are required to be made for 8 objects to be weighed, either the above design may be used or

(3) any row of H_8 may be added on twice to H_8

or

(4) two different rows of H_8 may be added to H_8

The variance factors in (3) are equal to 11/96 and those in (4) are equal to 7/64[2,6]. Hence the design given by (1) is superior to (3) but inferior to (4)

In general, when it is possible to construct an orthogonal matrix of order $N+2$ following the method (*IV*) of Plackett and Burman, the efficiency of the design so obtained may be compared with those of the designs obtained when either a row of H_N is added on twice to H_N or two different rows of H_N are added to H_N The variance factors given by the design of type (2) are

$$(5)\qquad \frac{1}{N+1}$$

The variance factors given by the designs of type (3) have been shown to be equal to

$$(6)\qquad \frac{N+2p-2}{N(N+2p)},\ \text{when } p \text{ objects are required to be weighed } (p\leqslant N)$$

There will be two sets of variance factors for the design under the type (4) It has been shown that the maximum efficiency will be obtained when these two sets of variance factors are the same and are equal to

$$(7)\qquad \frac{N+p-2}{N(N+p)},\ \text{when } p \text{ objects are required to be weighed } (p\leqslant N)$$

Now (5)<(6), if $p>\frac{N}{2}+1$ and (5)<(7), if $p>N+2$ which is not true

Mood[2] has given a best design for $N = p = 6$, for which the variance factors are 1/5 The following orthogonal matrix of order 6 obtained by method (*IV*) of Plackett and Burman also gives 1/5 as the variance factors

$$\left|\begin{array}{rrrrrr}
0 & 1 & 1 & 1 & 1 & 1 \\
1 & 0 & 1 & -1 & 1 & -1 \\
1 & 1 & 0 & 1 & -1 & -1 \\
1 & -1 & 1 & 0 & -1 & 1 \\
1 & 1 & -1 & -1 & 0 & 1 \\
1 & -1 & -1 & 1 & 1 & 0
\end{array}\right|$$

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24 12 1948

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VARIETAL RESISTANCE AND SUSCEPTIBILITY OF *PHASEOLUS RADIATUS* TOWARDS *CERCOSPORA*

Some varieties of *Phaseolus*, viz , *Phaseolus radiatus* L, (Hali mung), *P radiatus* var *grandis* Prain (Krishna-mung), and *P radiatus* var *aurea* Prain (Sona mung) were sown in the Dacca University Botanical Garden in October, 1948, for class use The seeds of the first two got intermixed and were sown together, while the third was sown separately About a month later all the three varieties were found to be infected with a species of *Cercospora*, probably *C cruenta* Sacc Of the three varieties, *Phaseolus radiatus* and *P radiatus* var *grandis* were the first to show the symptoms of attack Typical brown spots with a white centre were conspicuous Within a few days after the appearance of the fungus, the virulence of the attack became evident by the amalgamation of the spots and ultimate browning of the leaves Eventually the whole plot looked gutted as if it had been burnt (Fig 1, right side) Leaves, flowers, young pods and

Fig 1 Plots showing *P radiatus* var *aurea* (Left) and *P radiatus* and *P. radiatus* var *grandis* (Right)

even stems showed the scorched appearance Very few pods matured and others shrivelled at a very young stage Briefly, both the varieties completely succumbed to the attack of the fungus and this was specially marked in the case of *P radiatus*

The third variety, *P radiatus* var *aurea*, also showed a few spots here and there on the leaves but these never became amalgamated and the plants maintained their green appearance (Fig 1, left side) Both the pods and stems remained free from attack and a fairly normal seed set was obtained

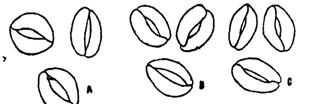

Fig. 2 Stomata from peels of leaf epidermis of *P radiatus* (A). *P radiatus* var *grandis* (B) *P. radiatus* var *aurea* (C), all drawn under same magnification

This marked difference in the incidence of the attack between *P radiatus* and *P radiatus* var *grandis* on the one hand and *P radiatus* var *aurea* on the other—although all three were sown in adjoining plots and at the same time—prompted me to examine peels of the leaf epidermis (Fig 2) The results are as follows

	P radiatus	*P radiatus* var *grandis*	*P radiatus* var *aurea*
No of stomata on the upper surface per sq mm	133	138	110
No of stomata on the lower surface per sq mm	332	243	221
Average size of stomatal pore	16 1×5 3	16 1×2 8	13 6×2

The data given above show that besides physiological causes, if any, the morphological differences amongst the three varieties with respect to stomatal frequency and pore size, might be responsible for susceptibility of the two varieties and resistance of the third The fewer stomata in *P radiatus* var *aurea* and their smaller pore size seem to give it a greater protection against the fungus

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STUDIES IN THE CATALYTIC PRODUCTION OF BUTADIENE FROM ETHANOL—I

Attempt to prepare Butadiene by the catalytic conversion of Ethanol over mixed catalysts have met with considerable success Lebedev[1] has patented a process for the same which has been a commercial success The nature of the catalyst and their composition, however, find no mention in chemical literature

Two catalysts have been studied in this laboratory The catalysts consist of magnesium oxide, silica and aluminium oxide in the ratios 75 15 19 8 5 058 respectively

Preparation of Catalyst I

The method of co precipitation of the various metallic carbonates by the addition of 20 percent potassium carbonate solution to the respective nitrate solutions in silica sol was resorted to The precipitate was filtered on a Buchner, washed and dried for 4 to 6 hours at 100°C The cake was powdered to 100 mesh and the powder activated at 350-375°C for 6 hours Water was added to the powder thus obtained and the catalyst caked out on a Buchner. Small pellets of the size 7 to an inch (approximately) were obtained from this and dried for 4 hours at 100°C

Preparation of Catalyst II

The mode of preparation and the sizes of the catalyst were the same as in the case of Catalyst I but the

precipitant was ammonium carbonate as the removal of the excess ammonium carbonate and ammonium nitrate by washing is easier than that of the corresponding potassium salts

Ethanol vapours were passed over a preheater bed and then over the catalyst, the gases were immediately cooled to 0°C and the condensate collected The uncondensed gases were then passed to the gas holder through a 50 percent solution of sodium hydroxide

TABLE I

Data for Catalyst I	Temperature 420–430°C	430°–440°C	440–450°C
1 Alcohol feed stock (absolute alcohol distilled over calcium)	50 0 cc	50 0 cc	50 0 cc
2 Alcohol returned %	40 2	42 0	49 6
3. Alcohol converted % (by difference)	59 8	58 0	50 4
4 Rate of delivery of alcohol ccs /1hr/1 gm of the catalyst	0 769	0 769	0 769
5 Gas collected (at N T P) litres	9 365	10 03	10 46
6 Composition of the gas (by vol)			
Unsaturated hydrocarbons	40 36	49 08	38 65
Hydrogen	42 90	34 22	46 40
Carbon monoxide	5 45	1 84	1 83
Saturated hydrocarbons	2 54	5 74	5 48
7 Butadiene content of gas g/l	0 564	0 567	0 451
8. Yield of products expressed as % by wt of absolute alcohol converted			
Hydrogen	1 53	1 38	2 19
Butadiene	22 35	24 78	23 68
9 Production of Butadiene on the basis of the theoretical yield	38 07	42 22	40 33

TABLE II

Data for Catalyst II	Temperature 420–430°C	440–450°C	465–475°C
1 Alcohol feed stock (absolute alcohol distilled over calcium)	50 0 cc	50 0 cc	50 0 cc
2 Alcohol returned %	48 57	48 0	37 14
3 Alcohol converted % (by difference)	51 43	52 0	62 86
4 Rate of delivery of alcohol ccs /1hr/1gm of the catalyst	0 769	0 769	0 769
5 Gas collected (at N T P) in litres	10 64	10 27	14 71
6 Composition of the gas (by vol.)			
Unsaturated hydrocarbons	43 63	56 28	58 53
Hydrogen	28 43	34 22	25 68
Carbon monoxide	6 37	2 47	1 46
Saturated hydrocarbons	1 47	3 46	7 80
7 Butadiene of gas g/l of gas	0 65	0 670	0 477
8 Yield of products expressed as % by wt of absolute alcohol converted			
Hydrogen	1 31	1 54	1 37
Butadiene	34 4	33 44	34 34
9 Production Butadiene on the basis of the theoretical yield	58 6	56 97	58 51

The results obtained are given in Tables I and II Further details will be published elsewhere

Our thanks are due to Sir J C Ghosh and Prof B Sanjiva Rao for their keen interest in this work

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Bangalore, 20-1-1949.

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TRIPLE SPLITTING OF IONOSPHERIC RAYS

The triplet splitting observed by Newstead[1] and Meek[2] is further proof of the validity of the theory of ionospheric reflection developed by Appleton[3] Though usually one ordinary and one extra ordinary ray is observed, according to the theory, as has also been pointed out by me,[4] one more extra ordinary reflection is possible from an ionospheric concentration greater than that needed for the reflection of the ordinary ray The circumstances favourable for this reflection were discussed theoretically by Taylor,[5] but such reflections were first observed by the workers in the Physical Laboratory of the Allahabad University[6] and a correct interpretation was also given[7]

The notes published by Meek and by Eckersley[8] give an incorrect impression that Harang[9] was the first to observe triplets corresponding to the theory As a matter of fact Harang has himself acknowledged the earlier work done at Allahabad The triplets observed by Eckersley, viz., two ordinary rays and one extra-ordinary ray, seem to belong to different

mechanism and is not according to the theory of ionospheric reflection which demands only one ordinary ray and two extra ordinary rays

The first paragraph of Meek's note gives an impression that the theory indicates a triple splitting only in the polar regions where the earth's magnetic field is vertical However, according to the theory, the reflection of the extra ordinary rays depend upon the *total* earth's magnetic field and not upon its direction This is confirmed by experimental results obtained at Allahabad and Tasmania, where the earth's magnetic field is not vertical

Lady Jamshedji Road, Bombay, 7 2 1949 G R TOSHNIWAL

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SULPHUR-ISOMERISM OBSERVED IN 4 S BENZYL 4 METHYL PENTANONE 2

While studying the synthesis of a number of biologically important amino acids containing sulphur, by an extension of Schmidt's reaction on substituted aceto acetic esters, we made the following important and unexpected observation By the addition of benzyl mercaptan, to isopropylidine aceto acetic ester, and which did not solidify even on cooling to—10°C The compound, however, very readily formed a semicarbazone (melting point 125°C) Further, *this compound (B) on refluxing with hydrochloric acid* (1 2) *was transformed into the compound m p 48°C described above (A)* The two compounds did not show any depression of melting point on admixture, and *their crystalline* structures were identical.

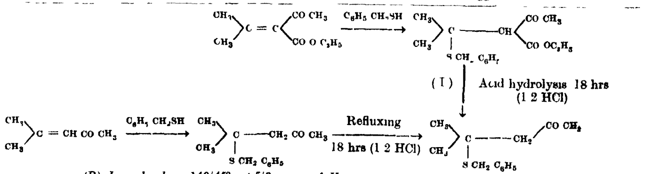
The elementary analysis of sulphur gave

calculated for $C_{13}H_{18}OS$		S	14 41%
α compound	found	S	14 85%, 14 37%
* β compound	found	S	14 58%, 14 37%

An extensive search of literature, revealed that exactly similar type of sulphur isomerism was, observed by Hinsberg [1] "When phenyl sulphide is warmed with perchloric acid it gives a perchlorate of sulphonium base on treating it with alcoholic potash, a new compound is formed which is structurally identical with the starting material phenyl sulphide and is linked with it, by sulphur isomerism" Hinsberg (*loc cit*) made analogous observation in the aliphatic series about *n* butyl sulphide

The detailed report of our investigations to explain the exact nature of sulphur isomerism, dealing with the chemical and physical aspects of the problem will be published in the near future

Our thanks are due to Dr D M Bose, Director, Bose Research Institute, for his sympathetic encouragement and the keen interest shown during this investigation Our sincerest thanks are also due to Prof S N Bose, Khaira Professor of Physics, Calcutta University, for helpful and critical suggestions



(B) *Liquid* b p *140/45°c at 5/6 m m of Hg* (A) *Solid* m p *48°c*

* β 4 S Benzyl 4 methyl pentanone 2 * α 4 S Benzyl-4 methyl pentanone 2

we obtained Ethyl β s benzyl α aceto-isovalirate (I) (b p 152 158°C at 5 6mm of Hg) On hydrolysis with hydrochloric acid (1 2) a liquid (b p 130° 35°C at 6 mm of Hg) (A) which solidified on cooling and after crystallization from alcohol, *melting at* 48°C was obtained No solid semicarbazone could be obtained from this compound With a view to establish its constitution we attempted to prepare the same compound by the addition of Benzyl mercaptan to Mesityl Oxide The product was, however, a liquid *b p* 140/145 *at 5 6 mm of Hg* (B)

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*The notation α and β was introduced in order to distinguish the two iso meric forms following the suggestion of Hinsberg.

SCIENCE AND CULTURE

A Monthly Journal of Natural and Cultural Sciences

Vol 14 | MAY 1949 | No. 11

REORGANIZATION OF AGRICULTURAL DEPARTMENTS IN INDIA

NO apology is offered in drawing attention of the agricultural scientists, leaders in public thought and Governmental authorities in the country to the article, published elsewhere in this issue, on the nature of the organization of the Department of Agriculture of the Government of the United States of America The article has presented in considerable details how the different activities of the Department are organized into several units to discharge effectively and efficiently the various functions assigned to it by acts of the U S Congress from time to time Today the United States stands in production of agricultural commodities, as in the field of industry, far ahead of any other country This leadership in agricultural production has been rendered possible, apart from a few other contributory factors, by the elaborate and effective organization that had been created to translate quickly into action the programmes and policies laid down by the people's representatives in the United States Congress We therefore urge that careful and critical attention be given to the lessons obtained from such a study of the organizational machinery that made such advancement possible

The U S Department of Agriculture spends 1805 million dollars (601 crores of rupees) annually (*i e*, 5 per cent of the total budget of the U S Government) and employs a personnel of over 82,000 workers. Out of a total national income of over 200,000 million dollars, cash receipts from farm marketings aggregated to nearly 31,000 million dollars in 1948 In India agricultural commodities contribute a proportionately much greater share to our total National income, yet we find a very meagre establishment in agriculture in our Governmental set-up, and, that too, judged by its performances is not certainly very efficient

The World War II and subsequent years have shown how deplorably India is dependent on foreign countries for food commodities to keep the population out of the grip of actual starvation—not to speak of providing adequate supplies to assure the Nation of a certain minimum standard of balanced nutrition The country has been passing through such a state of unhappy affairs for the last six to seven years, yet we see no improvement today anywhere in any aspect of our agriculture nor are there sure signs that things will definitely improve in the near future The figures presented recently in the Indian Parliament by the Food Minister gave a dismal picture In 1945, the country imported 850,000 tons of foodgrains at a cost of over 20 crores of rupees These figures rose to 2,840,000 tons and 129 crores of rupees respectively in 1948 The outlook for 1949 is no better How long can a country spend crores and crores of rupees in importing food commodities from foreign lands to keep her population just going?

While the country has been passing through such a severe crisis since the early 1940's an analysis of the whole affair of things will show that the Government of India is trying to fight such an unprecedented situation with an organizational machinery that has out lived its usefulness In contrast to the static nature of agricultural organization in this country, the U S Department of Agriculture has, since its inception, been showing great dynamicity and youthful vigour in moving with the times to meet the changed circumstances—social or economic Within the recent years the U S Department of Agriculture has undergone major organizational changes in 1917, 1932, 1935 and in 1942 Even as late as 1945 a new agency, *viz*, the Production and Marketing Administration was created under the Department to unify under one coherent administrative unit the various offices that were so long independently carrying on activities concerning production, marketing, grading of commodities, warehouse inspection and services for improvement of

marketing facilities as well as settling production goal for the country In the sphere of agricultural research and technological development, the Agricultural Research Administration was created in 1942 for unifying and consolidating all research activities of the Department and also for over-all planning and co ordination of the same To help maintain close touch with the research activities and other programmes of work at the various agricultural experiment stations located in the individual States, there exists under the U S Department of Agriculture a separate agency, *viz*, Office of Experiment Stations whose main function is to suggest and encourage active co operation among the State agricultural experiment stations and to promote solution of problems that extend beyond the borders of any one individual State In our Indian set up we find a complete absence of such an useful agency to bring about much needed co operation and co ordination in the programmes of work—research or otherwise—between neighbouring Provinces or among the Provinces and the Centre

Another important agency that has contributed largely to the agricultural progress in the U S A is what is known as the Extension (=advisory) Service This agency is charged with the responsibility of bringing into the hands of the farmer the results obtained in the laboratories of the universities and the agricultural experiment stations Its field of activities includes varied aspects of the life of the farm communities and

"some of the areas and ways in which this Service has accomplished important results are Counselling on farm problems, securing application of the findings of research on the whole range of farm operations from land use, soil treatment, crop and livestock production to better farm management and business methods, better homes and better farm and community living, working with rural youth, helping farmers solve problems through group action, mobilising rural people to meet emergencies, developing an understanding of the economic and social factors affecting family living and agriculture in general" *

The need for such an Extension Service, where its necessity is all the more greater because of the appalling illiteracy among the farm population, cannot be over emphasised

In the field of agricultural education, there exist in the U.S A today 69 Land Grant Colleges (mostly of university status) imparting instructions on the graduate or post graduate level in agriculture, along with other liberal arts and science subjects, to a full time enrolment of over 300,000 students The total expenditure on these 69 institutions for the year 1945 46 was over 257 million dollars 76 million dollars came from the Federal Grant funds, while the remaining 181 million dollars were received from the individual States * While in India 75 per cent of the population is dependent on farming, there are hardly more than a dozen agricultural colleges and the number of students undergoing instruction will not exceed a few thousands

* Joint Committee Report on Extension Programs Policies and Goals. U S Dept Agri and Association of Land Grant Colleges and Universities, 1948

Universities in all countries have been the citadel of progressive thoughts and advanced ideas Because of the definite policy, the then British Government in India discouraged establishment of agricultural colleges near or within the university campus or as a department of the university itself As such we find our agricultural colleges isolated physically and in thought, and far behind our university departments in their achievements in original research or applied fields This situation calls for immediate remedy In the United States almost all the agricultural colleges and the State agricultural experiment stations are located in the university campus and often in the same buildings Such are the co ordination of work and co-operation in spirit that one can hardly notice where one organization ends and another begins The same professor will often teach in the university and perform work of the agricultural experiment station, his salary being book adjusted on the length of time devoted on the work of the agricultural college, university and the experiment station

What is needed is a thorough reorganization of our agricultural structure both in the Centre and the Provinces Establishment of a research bureau here or an institute there will not materially improve the situation Such an over all reorganization will of course involve a considerable adjustment but will not necessarily involve huge expenditure unless and until our National finances so permit In the light of several discussions that we had had with the deans of many agricultural colleges and directors of State agricultural experiment stations (in U S A), it can be said with emphasis that all or most of our Provinces can have an agricultural college, as they exist in the U S A , organized out of the different related departments in our universities by adding a few personnel in specialized branches and acquiring a few hundred acres of land in an adjoining or nearby locality For this purpose the services especially of the biological, chemistry, economics and engineering departments of our universities should be harnessed to their capacity in this drive for extending, and improvement of, agricultural teaching, research and extension and advisory services to practical farmers This will save huge sums in maintaining separate agriculture colleges at different locations, save expenses on buildings, help conserve building materials for other urgent purposes, save on library books and journals, and laboratory equipment too hard to obtain and so costly to acquire anew these days In case of the Provinces which still possess no universities of their own, the agricultural colleges and the agricultural experiment stations might serve as the nuclei around which to build universities as were done in the cases of so many useful Land Grant (agricultural) institutions of the United States

Lastly, our agricultural set-up was fashioned by Britishers and manned by personnel trained according to the British system England had never been an 'agricultural'* country, and it should be profitable to

keep in mind while drawing our own plan of agricultural reorganization that she herself is now employing American methods and ideas in her new development projects of agriculture in the homeland or abroad Besides borrowing ideas and information from progress made in advanced countries, what we need most essentially is personal initiative and sincerity of purpose and a sense of responsibility in the top and also down the ranks if we mean any quick improvement in the agricultural situation in our Indian Union

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ORGANIZATION AND OPERATION OF THE UNITED STATES DEPARTMENT OF AGRICULTURE

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BECAUSE of considerable importances and necessity for re organization of Agricultural Departments in India, the writer is taking this opportunity to present a detailed account of the organization of the United States Department of Agriculture and how its various activities are grouped into different offices, etc, for successful, effective, and efficient discharge of its duties and obligations to the people of that country Its field of operations touches upon almost every aspect of the life of the people of that great nation No one article, therefore, far less the present one, can claim to give a complete picture of all the activities carried on by or under the auspices of the U S Department of Agriculture However, an attempt has been made hereunder to provide information on certain important aspects of the working of the Department

In a country like India, which is 75 per cent agricultural, no other single phase demands more serious and immediate attention of our Government and of the thoughtful section of our public than agriculture itself To regenerate and reinvigorate agriculture, to raise it out of the decadence to which it has fallen during the course of the past several generations, is one of our most urgent national problems This article has, therefore, been written to focus attention on certain basic aspects of the organization and methods of operation of the U S. Department of Agriculture, which has contributed so much to secure for that country a great lead in agricultural progress These might serve as lessons and inspirations in the task that lies ahead of us in reorganizing agricultural activities at the governmental level in India and thereby to help make agriculture a major, well-organized national industry on a sound economic basis and a profitable and welcome occupation for many millions of our people, whose very existence depends on agriculture alone

Origin and Evolution of the Department

The U S Department of Agriculture began its career in the 1830's in a very humble way as an outgrowth of agricultural activities at first carried on in the Patent Office, then under the Department of State, without any special appropriations In 1839, however, the U S Congress authorized the then Patent Office to expend $ 1,000 out of current income for agricultural purposes, especially for the collection of valuable plants and seeds and for compilation and dissemination of agricultural statistics

The Department of Agriculture as an individual and separate unit of the Government was created by an Act of the U S Congress, May 15, 1862 The next big step was the bill passed by the U S Congress, which became law in February 9, 1889, making the head of the Department of Agriculture a member of the President's Cabinet With the appointment of a Secretary of Agriculture (which in our governmental set-up is equivalent to Minister of Agriculture), the Department really began to gain recognition, status and importance It soon began to grow in size and service to the people Because of increasing complexities and competitive conditions in agricultural enterprises, more demand was being made upon the Federal Government to have a reliable and really efficient department at the capital of the country to advise them and serve them in matters which are beyond the capacity of the individual farmers to handle

Below are mentioned a few of the most significant steps in the history of the Department which, during the course of the years following, have gradually brought it to its present status

Establishment of Land-Grant (Agricultural) Colleges One of the most important Acts ever passed by the U S Congress which has helped so much to gain the leading place in technological advancement in agricultural sciences, was the legislation making agricultural education more extensive and intensive as well The First Morril Act, passed in July 2, 1862, provided a donation to each of the individual States in the federation of 30,000 acres of public land for each Senator and Representative in the Congress to which the States were respectively entitled In all, 11 million acres of

public land were thus set aside by the Government as an endowment The Act specified that the sale proceeds and/or revenue from the said land should be used only for the purpose of the establishment and/or

"endowment, support, and maintenance of at least one college where the leading object shall be, without excluding other scientific and classical studies, and including military tactics, to teach such branches of learning as are related to agriculture and the mechanic arts"[1]

To prevent dissipation of the fund on unproductive items the Act further stipulated that no income from the land and/or

"the fund, nor the interest thereon, shall be applied directly or indirectly, under any pretense whatsoever, to the purchase, erection, preservation, or repair of any building or buildings"

and to hasten the attainment of the objectives of the Act it was further enjoined that

"any State which may take and claim the benefit of the pro visions of this act shall provide within five years, at least not less than one college" (pp 3 4)[1]

By subsequent Acts of the U S Congress the Second Morill Act of 1890, the Nelson Act of 1907, and the Bankhead Jones Act of 1937, and a few others, additional provisions were made from the Federal funds to meet the growing needs of these so called land grant institutions

Today there are in existence in the U S A 69 land-grant institutions (mostly of university status) imparting instructions on graduate or post-graduate level in agriculture, along with other liberal arts and science subjects, to a full time enrolment of 309,870 students The total expenditure for these institutions for the year 1945 46 was over 257 million dollars (=85 crores of rupees)[2] Over 76 million dollars came from the Federal grant funds under the above acts, while the remaining 181 million dollars were received from the individual States

The harnessing of every new development in science to the progress of agriculture in the U S A became possible due only to these thousands of trained young people, who in due course turned to farming or other wise took up positions in agriculture based industires and applied the training and knowledge gained in the land grant colleges and universities to grow "two blades of grass where one grew before" or to get "plastic out of a corncob"

In our national planning of agriculture, prime consideration should be given to making agricultural and allied education much more liberal and wide-spread so as to provide the country with a vast body of trained young people, who will, in the course of the next generation, form a goodly percentage of our farmers, supply teachers for our agricultural institutions, and technicians for our experiment stations and agriculture-based industries Our success or failure to improve the country's agricultural situation will depend on how soon and to what extent we are able to provide ourselves with a vast body of young men equipped with the best scientific training possible

Establishment of State Agricultural Experiment Stations In 1887 a legislation, popularly known as the Hatch Act, was enacted by the U S Congress authorizing Federal grants to help individual States establish their own agricultural experiment stations under the direction of, or as a department of the land grant college or colleges in each State

"in order to aid in acquiring and diffusing among the people of the United States useful and practical information on subjects connected with agriculture, and to promote scientific investi gation and experiment respecting the principles and applications of agricultural science"

"That it shall be the object and duty of said experiment stations to conduct researches or verify experiments"

bearing upon useful plants and animals, soils and manures, food and forage, etc , and

"such other researches and experiments bearing directly on the agricultural industry of the United States as may in each case be deemed advisable, having due regard to the varying conditions and needs of the respective States or Territories"

It was further enjoined in the Act that each experiment station should publish at least one bulletin or progress report once in three months and that copies of them should be sent to each newspaper in the States or Territories in which they are respectively located as well as to all other experiment stations all over the country, in order to keep the public and the experiment stations informed of what was going on in the other experiment stations It was further provided that

"such bulletins or reports and the annual reports of said stations should be transmitted in the mails of the United States free of charge for postage"

The above quotations have been taken at length from the Hatch Act of 1887 to show the wide scope of operations given to the State agricultural experiment stations under the terms of the Act and the great wisdom and forethought shown in providing for the free mailing (postal) service for bulletins, reports and correspondence emanating from these experiment stations To what a great extent this provision for free postal service has facilitated the dissemination to the farmers of the knowledge gained in the laboratories of these experiment stations cannot be over-estimated

As the activities of these State agricultural experiment stations were growing day by day, additional recurring Federal-grants have since been provided under the Adams Act of 1906, the Purnell Act of 1925, the Bankhead Johnes Act of 1935, and a few other supplementary acts.

[1] Federal Legislation, Rulings, and Regulations affecting the State Agricultural Experiment Stations U S Dept Agri. Misc. Pub 515, 1946

[2] Statistics of Land Grant Colleges and Universities year end ing June 30, 1946 U S. Office of Education Bull 14, 1947

The total of Federal grant research funds available to the 53 State agricultural experiment stations, established under the original Hatch Act of 1887, for the fiscal year 1945 46 was over 7 million dollars (=over 2 crores of rupees) The total sum available for expenditure to these agricultural experiment stations for 1945 46 was over $33 million (=10 crores of rupees)[3] In other words, for every help of $1 from the Federal-fund, the States expended nearly $4 for these agricultural experiment stations

Establishment of the Office of Experiment Stations One year later, i e, in 1888, the Office of Experiment Stations was created to administer Federal grants for research available to the agricultural experiment stations established under the Hatch Act of 1887 and later supplementary enactments In administering these Federal grant funds, the Office of Experiment Stations of the U S. Department of Agriculture evaluates and approves of new and revised research proposals submitted by the various State agricultural experiment stations, encourages and suggests co operative research among the experiment stations to promote the solution of problems that extend outside the borders of any one State and which are beyond the means of any one State to solve all by itself During the review of research projects submitted by the States, the Office of Experiment Stations calls attention to pertinent research at other agricultural experiment stations or in the U S Department of Agriculture itself, suggests the possibilities of exchange of information or arranges for more formal co operation between the stations where this seems desirable and feasible, helps draw and approves of the formal memoranda of understanding between experiment stations, and between experiment stations and the research bureaus of the U S Department of Agriculture Over 1200 formal memoranda of understanding were in effect during 1946 47 [4]

Establishment of Research Bureaus First to be founded, in 1884, was the Bureau of Animal Industry in response to a special Act of the U S Congress authorising its establishment to aid in the control and eradication of diseases among cattle and useful animals No more bureaus were established until James Wilson became the Secretary of Agriculture Under Secretary Wilson's administration (March 1897—March 1913), the U S Department of Agriculture made the most outstanding progress in several respects Under Wilson's initiative the Bureaus of Soils, Plant Industry, Forestry, and Chemistry were established in 1901, the Bureaus of Entomology, and Biological Survey in 1904 Many of these bureaus established in the early 1900's are still functioning, in some cases modified in name but greatly enlarged in scope and activities Several new bureaus have since been created

[3]Report of the Agricultural Experiment Stations for 1946 U S Dept Agri, 1947

[4]Report of the Administrator of Agricultural Research: 1947. U. S Dept. Agri., 1948.

Another era characterized by the creation of a number of the "action" agencies began in 1933 Soon were established such new "action" agencies as the Commodity Credit Corporation, Farm Credit Administration, Rural Electric Administration, and Soil Conservation Service

Dynamic Characteristics One of the most important characteristics of the Department has been that it has never remained static but tried always to move with time to face changing situations—social or economic To streamline its activities to meet the increasing demands made on agriculture for successful war efforts, a major reorganization of the Department was announced on December 13, 1941, and this was immediately given effect to by Executive Order of February 23, 1942 The effect of this Order in consolidating and unifying all research activities of the Department under a single administrative unit has been discussed later under *'Over All Planning and Co-ordination of Research Activities'*

Production and Marketing Administration Another landmark in the evolution of the Department was the creation on August 8, 1945, of the Production and Marketing Administration for unifying under one coherent administrative unit various offices which were so long independently carrying on activities concerning production, marketing, consumption, etc This Production and Marketing Administration is now charged with the responsibilities of setting production goals, announcement of price support for commodities to prevent production falling below set goals, administration of farm marketing quotas for foreign countries, administration of commodity loans helping development of new food uses and consumption of foods in abundant supply It keeps a strict eye on the grading of agricultural commodities, inspects warehouses, and provides service for the improvement of marketing facilities

FUNCTIONS AND OBLIGATIONS

The U S Department of Agriculture is directed by law to acquire and disseminate useful information on agricultural subjects in the most general and comprehensive sense It performs functions relating to agricultural education, marketing, conservation, and other regulatory work It conducts researches in agricultural chemistry, industrial uses of farm products, soils, entomology, agricultural engineering, agricultural economics, marketing, crop and live-stock production, production and manufacture of dairy products, human nutrition, home economics, and conservation of land and agricultural resourses It seeks to promote efficient use of soils and forests It is also required by law to make research results available for practical farm use through extension and demonstration work It publishes crop reports, provides commodity standards, Federal meat inspection service and other marketing services It seeks to control and eradicate plant and animal diseases and pests and is required to enforce

laws designed to prevent introduction of foreign pests and diseases It provides rural rehabilitation, guarantees the farmer a fair price and a stable market through commodity loans, supplies agricultural credit, assists tenants to become farm-owners, and facilitates the extension of electric services to families living in farms in rural areas

Organization of the Department

It is worth studying how the work of the Department, which directly engages a body of 82,000 employees and expends 1,805 million dollars (=601 crores of rupees) a year*, organizes itself to discharge the varied functions entrusted to it

On the basis of functions assigned to the agencies, they can be grouped into three kinds

I *Staff Agencies*

1 Office of Administrator, Research and Marketing Act
2 Bureau of Agricultural Economics
3 Office of Budget and Finance
4 Office of Foreign Agricultural Relations
5 Office of Hearing Examiners
6 Office of Information
7 Library
8 Office of Personnel
9 Office of Plants and Operations
10 Office of the Solicitor

The above agencies are concerned with the day to day administration and similar routine duties of the Department

II *Program and Service Agencies*

1 Commodity Exchange Authority
2 Extension Service
3 Farm Credit Administration
4 Farmers Home Administration
5 Federal Crop Insurance Corporation
6 Forest Service
7 Production and Marketing Administration
8 Rural Electric Administration
9 Soil Conservation Service

These agencies perform most of the operating and regulatory functions of the Department In addition, Forest Service, Soil Conservation Service, and Production and Marketing Administration perform some research in the physical and biological sciences

III *Research Agency*

Agricultural Research Administration

This agency is concerned with the over all planning, co ordination and administration of all the research activities carried on by the various 'bureaus' of the Department of agriculture

The work of the agencies are next divided into 'Divisions' and the Divisions into 'Sections' In the case of larger agencies, like the Production and Marketing Administration, the agencies are first subdivided into 'Branches' before they are formed into 'Divisions' and 'Sections'

* (Estimated) agricultural budget for 1949 50.

Organization of Research Activities

Over 31 million dollars (=over 10 crores of rupees) were expended by the U S Department of Agriculture on research alone during the fiscal year 1947 Expenditure by type of research was as follows fundamental research—$ 2 4 million, developmental research—$ 4 4 million, background research—$ 10 7 million, and applied research—$ 13 7 million The total number of personnel engaged in research was 7577

Bureaus Almost all the research activities of of Department are directly conducted by the research bureaus The naming of the existing Bureaus, enumerated below, indicates the principal nature of activities they are directly concerned with, and no space will be taken to add any further explanation

Bureau of Agricultural and Industrial Chemistry
Bureau of Animal Industry
Bureau of Dairy Industry
Bureau of Entomology and Plant Quarantine
Bureau of Human Nutrition and Home Economics
Bureau of Plant Industry, Soils, and Agricultural Engineering
Office of Experiment Stations

The work of each of these Bureaus is next divided into several 'Divisions' and the 'Divisions' into 'Sections' The 'Divisions' under each Bureau may be classed in two groups Divisions such as the Division of Finance and Business Administration, the Division of Information, the Division of Personnel, etc , are known as "Service Divisions" , while others such as the Division of Cereal Crops and Diseases, the Division of Cotton and other Fiber Crops and Diseases, the Division of Mycological Collections and Disease Survey conducting research directly, are known as "Subject Matter Divisions" of the bureau

Regional Laboratories for Plant and Animal Sciences To tackle problems of regional nature which are difficult or impossible for an individual State or a group of States to handle successfully, provisions have been made under the Bankhead-Jones Act, passed by U S Congress, June 29, 1935, for joint enterprise by the Federal and State agricultural experiment stations

Nine regional laboratories, popularly called 'Bankhead Jones Laboratories,' after the names of the sponsors of the Act, were soon established to undertake solution of problems pertaining at those regions. They are as follows

1 U S Regional Salinity Laboratory, at Riverside (California)
2 U S Regional Plant, Soil, and Nutrition Laboratory, at Ithaca (New York)
3 U S Regional Pasture Research Laboratory, at State College (Pennsylvania)
4 U S Regional Soyabean Laboratory, at Urbana (Illionis)
5 U S Regional Vegetable Breeding Laboratory, at Charleston (South Carolina)

6. U S Regional Swine Breeding Laboratory, at Ames (Iowa)
7 U S Sheep Breeding Laboratory, at Dubois (Idaho)
8 U S Regional Laboratory for Improvement of Vitality in Poultry, at East Lansing (Michigan)
9 U S. Regional Animal Disease Laboratory, at Auburn (Alabama)

The first five laboratories concerned with plants and/or soils are under the charge of the Bureau of Plant Industry, Soils, and Agricultural Engineering, while the last four laboratories, concerned with animal sciences, are under the direction of the Bureau of Animal Industry

Laboratories for Research on Industrial Uses of Farm Produce Another line of research activities of the U S Department of Agriculture that needs mention is the one concerned with finding new and wider uses of farm commodities Faced with over production of farm commodities in the late 30's, the U S Department of Agriculture tried to meet the situation by harnessing science to find newer channels for commodities in over production and not through the too easy way (if that is a solution at all !) of compulsory restriction of cultivation, as India did with jute then in over production in the late 1930's

The U S Congress in the Agricultural Adjustment Act of 1938 authorized appropriations for research and experimentation for the improvement of methods of processing, utilizing, and preserving agricultural commodities, and for developing new and wider uses for industrial and food purposes

To implement the above Act of 1938, four regional research laboratories were soon established respecting the principal crops grown in each of those major agricultural producing areas of the United States The Northern Regional Research Laboratory located at Peoria, Illinois, carries on investigations to find new uses of corn, wheat, and other cereals, soyabeans and other oil seed crops, agricultural residues such as straws and stalks the Southern Regional Research Laboratory at New Orleans, Louisiana, is engaged on similar studies relative to cotton, sweet potatoes, ground nuts, and other oil seed crops, the Eastern Regional Research Laboratory at Wyndmoor, Pennsylvania, is engaged on such items as apples, potatoes, and other vegetables, tobacco, tanning materials, hides and skins, milk products, and animal fats and oils, while the Western Regional Research Laboratory at Albany, California, devotes attention, mainly, to fruits, vegetables, alfalfa, poultry products and by-products

Many of the items of investigations in these laboratories are operated on a "project" basis under the leadership of one or more investigators Depending on the nature of the 'project', part of the work may be carried on in the laboratories of other bureaus As soon as work on a "project" is concluded, a report is "prepared in the public interest as a brief report of noteworthy research" and published in the form of a "Research Achievement Sheet" by the Agricultural Research Administration It gives a short résumé of the new uses found or new products obtained, the estimated cost of the new discovery or development or achievement More than one hundred such "Research Achievement Sheets" have been released for public information on outstanding research achievements by these regional research laboratories alone or in cooperation with other research bureaus

Over all Planning and Co ordination of Research Activities

Research in the U S Department of Agriculture has an intimate bearing on all its other functions The Department relies heavily upon research as a major instrument in shaping broad policies and programs and in evolving newer technological methods to increase yield per acre, improving quality, nutritive value, utilization of farm waste and saving of human labour Accordingly, great care and attention has always been paid to finding ways and means for efficient management of the research activities of the Department as a whole

Agricultural Research Administration In order to assist in the over all planning and co ordination of all researches carried on by the several 'independent' research bureaus, in order to make the most effective and economical use of the research facilities, funds, and technical personnel available, a new approach was recently initiated The Agricultural Research Administration was created in 1942 by an Executive Order and charged with the above responsibilities All the research bureaus doing biological, chemical, physical and agricultural engineering research in the Department were placed under this unified administration Because of the success with which the Administration could bring about effective co-ordination in research activities among the different research bureaus, its sphere of operation has since been enlarged This agency is now entrusted with the co ordination of all research activities of the Department of Agriculture except economic research

Co operation and co ordination in research programs among the agricultural experiment stations of the 48 States and the research bureaus and other agencies having research functions is effected through the Office of Experiment Stations, whose chief is also one of the Assistant Administrators of the Agricultural Research Administration

It may be noted here with interest that considerable attention has been given by the U S President's Scientific Research Board in its "Report to the President" to finding means to bring about more effective co-ordination, and avoidance of duplication, in the research activities carried out under the several departments of the U S Government and to get the most out of every dollar of the $625 million (over 200 crores of rupees), excluding atomic energy, that the Federal

Government alone is spending on research each year since the last war [5]

The necessity for bringing about effective co ordination in the research activities of the different branches of the agriculture department, nay among all the departments of the Central government, and between the Central agriculture department and those of the Provinces of the Indian Union becomes all the more imperative when we consider our limited finances, too limited equipment and extreme shortage of technical man power

BUDGETING AND ACCOUNTING RESEARCH

In order to improve budgeting and fiscial accounting of research activities, the Agricultural Research Administration uses what is known as a 'project system' The project system provides a means whereby proposed new work may be considered in relation to proposals from all other bureaus and agencies and in the light of the record of the existing programs in operation It also helps find out how much money has been expended on a particular crop as well as on a particular line of investigations concerning the same crop, and to help judge what achievement has been obtained in relation to the amount of money expended Taking the budget, say, of the Bureau of Plant Industry, Soils and Agricultural Engineering, as a model, the entire budget of the Bureau is first divided, barring intricacies of special purpose funds, into a number of appropriations, such as (1) Field Crops Appropriation, (2) Fruits, Vegetables and Specialty Crops Appropriation, (3) Forest Diseases Appropriation, (4) Soils, Fertilizers, Irrigation Appropriation, (5) Agricultural Engineering Appropriation, and (6) National Arboretum Appropriation

Since an 'appropriation' covers a wide range, it is next sub divided into a number of 'financial projects' Cereal Production, Breeding, Disease, and Quality Investigations form one 'financial project', Cotton Production, Breeding, Disease, and Quality Investigations form another financial project, and so on and so forth A financial project is next divided into a number of 'work projects', all works concerning rice comprise one work project, those concerning wheat form another work project and so on Each work project is comprised of a number of 'line projects' A line project represents a rather narrow phase of research Investigations regarding disease control of rice form one line project, breeding disease resistant rice varieties may comprise a second line project, research regarding yield improvement may form a third line project, and so on, under the main work project concerning the rice crop

The project system of budgeting and accounting, in the words of the Administrator, Agricultural Research Administration, U S Department of Agriculture, is

"extensively used by the (Agricultura Research) Administration in keeping record of all research in progress and for getting team work between the different units of the Administration" (p 6)[6]

[5] A Report to the President The [U S] President s Scientific Research Board (John R Steelman, Chairman) Vol 1 Science and Public Policy, 1947 Vol III Administration for Research, 1947

[6] The Administration of Federal Research Talk by W V Lambert, Administrator of Agricultural Research, U S Dept Agri, before the Ame Assoc Adv Sci, Chicago, Ill, December 29, 1947 (memeographed)

PERENNIAL PEACE !

The President of the United States of America has declared the other day that he will not hesitate to release the atomic bomb once again for maintaining the world peace, the authorities of the Soviet Russia also are working assiduously to the same end by encouraging communistic groups in every land to fight with arms their own Government in power for the time being The two most powerful nations of the world to-day have thus allied themselves in closest co-operation for the achievement of this noble task Humanity, therefore, may now feel relieved at this prospect of permanent peace, and the United Nations' Organization accordingly wind up their expensive business as there is little necessity for keeping up that show any more ! The money saved thereby may be made over as contribution to the two great powers for promoting their co operative efforts in the cause of world peace We venture to nominate the President of the United States of America and the Premier of the Union of Soviet Socialist Republic for the Nobel Peace Prize for 1949.

ABORIGINAL POPULATION AND THEIR PLACE IN THE NATIONAL LIFE OF INDIA*

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THE people of India contain a large number of primitive tribes who subsist on hunting, fishing or by simple forms of agriculture Various terms have been used to describe them, such as 'aboriginal', 'jungle folk', 'primitive race' etc Of these the term 'aboriginal' is more appropriate in the sense that, if not the indigenous, they are certainly the oldest known inhabitants now living in this country

Their total strength in undivided India, as estimated in the Census of 1931, was roughly over 22 millions In the Indian Union, after partition, it would be about a million less, but accurate figures will not be available until the coming Census, for, in the 1941 estimates, there had been some confusion between the aboriginal and the scheduled Castes and the figures obtained were not always dependable

Broadly speaking, there are three distinct zones in which the aboriginal population of India can be divided, namely a *North Eastern*, a *Central* and a *Southern Zone*

In the first or *the North Eastern Zone*, there are roughly three million people beginning from the *Lepchas* of Sikkim to the *Kuki Lushais* on the Frontiers of Assam and Burma They are scattered over a large area in the Sub Himalayan region and the contiguous parts of Assam On the whole they form a compact block and with minor interruptions are continuous along the whole of the North Eastern Frontiers of India and even merging gradually into those of Burma and Southern Yunnan from which no strict line of demarcation can be drawn

Those who inhabit the Sub Himalayan region, contain among others, the *Lepchas* of Sikkim and the Darjeeling District The Rava, Mech, Kachari and the Mikir, Garo and Khasi of the Central Massif, separating the Brahmaputra from the Surma Valley, constitute an inner ring whose outer perimeters are formed by tribes living in the hinterland between Assam and Tibet, and the mountain ranges and valleys that divide India from Burma For administrative purposes they have been grouped into separate tracts, such as the Balipara, Sadiya Frontier, the Tirap and the Naga Hills Tract and quite recently the Abor Hills has been formed into an independent unit Very little authentic information is available on the tribes living in these tracts excepting the Naga tribes On the Western borders, the entire region beyond the MacMohan line is almost a *terra incognita* Neither the land nor the alignments of the tribes are known Of the tribes that live here, the *Aka*, the *Dafla* and the *Miri* are on the west of the Subansiri river, the *Uppa Tani* on the Upper Subansiri, and on both sides of the Dihong are the Abor group consisting of the *Galong*, *Pasi*, *Minyong* and the *Padam* The *Mishmis* with their sub-tribes occupy the country from the Dihong to the Lohit river, the *Chulikata* and the *Bebejiyas* living on the Western, and the *Digaru* and the *Meju* on the eastern parts Further east, stretching towards Burma but within the Sadiya Frontier Tract, are to be found the *Khamtis* and somewhat to their south west, the *Singphos* From the Tirap river further east, to as far south as Manipur, and extending westwards beyond the Dhansiri up to the Rengma Hills in Golaghat District, lies the home of the *Naga* tribes, which on the east includes the valleys and mountain ranges up to the Patkoi and across it to the western parts of the Hukwang Valley of Northern Burma On the Indian side, the *Nagas* fall into five major groups, of which the *Rangpan*, *Konyak*, *Sema*, *Angami*, *Lhota*, *Yimtsungar*, *Chang* and the *Rengmas* are most known In the adjoining Naga territory of Burma the chief tribes are the *Htangan*, the *Rangpan* and the *Haimi* who live in the north and centre of the Triangle

From Manipur the tribal territory extends through the Lushai Hills to the hilly parts of Tipperah and the Chittagong Hill Tracts which no longer forms part of India The tribes that occupy this region are the *Kukis*, the *Chins*, the *Lushais* and the *Hill Tipperahs*, who are either overflows of tribes from across the frontiers or are closely related In fact, along the entire north eastern frontiers of India there is no clear line of demarcation between Assam and Burma as far as the Chindwin river From the northern spurs of the Patkoi to the southern tips of the Chin Hills the whole tract forms a single geographical and ethnical unit closely knit in race and culture

Separated from the North-Eastern Zone by the Gangetic plains, is the Central Mountain barrier that divides the Northern from the Peninsular India which has provided a refuge for the aboriginal population from time immemorial The tribes living in this territory occupy the spurs and slopes of the Vindhya, Satpura, Mahadeo-Maikal and the Ajanta lines, stretching across the country and joining the Western with the Eastern Ghats They have expanded into the subsidiary hills as far north-west as the Aravalli and southwards into the uplands and forests of Hyderabad This mountain belt roughly between the Narvada

* Dr Mahendralal Sircar Memorial Lecture delivered at the Indian Association for the Cultivation of Science, Calcutta on February 23, 1949 The views expressed here are author's own views and do not indicate anything on the part of the Government

and the Godavari contains the largest assemblage of India's aboriginal tribes Beginning from the east, the most important tribes are the *Savaras*, *Godava* and *Bondo* of the Ganjam district, the *Juang*, *Kharia* and *Khond* of the Orissa Hills, the *Ho* and *Bhumij* of Singbhum and Manbhum and the *Santal*, *Oraon*, *Munda* of the Choto Nagpur plateau In the middle and western portions of the central mountain belt the most important tribes are the *Kols*, and the *Gond* and the *Bhils* The *Baiga* living principally in the Rewa State and the *Muria* and the Hill and Bison Horn *Maria* of the Bastar State are other important tribes of this region

Third major zone of India's aboriginal population falls south of the Kistna river below latitude 16° north Beginning from the *Chenchus* of the Nallaimallais Hills, the *Toda*, *Badaga*, and *Kota* of the Nilgiri Hills, the *Paniyan*, *Irula* and *Kurumba* of Wynaad, to the *Kadars*, *Hill Pantaram*, *Kanikar*, *Mal Vadan* and *Mala Kuratan* of the Cochin and Travancore Hills, the tribes are scattered over a wide territory, but mostly concentrated in the hills and forests of the south western tip of India

In addition to these three major zones, there are small groups in several parts of the country or within the Indian political boundaries Of these the *Andamanese* and the *Nicobarese* who live in the Islands bearing their names, though now separated from the main body of India's aboriginal tribes, are ethnically connected with them

These three principal tribal zones, although possessing some common elements, may be considered to be distinct from the points of view of race, language and culture

To begin with, in the Southern Zone which is numerically the smallest, there is an undoubted Negrito strain, although at present greatly submerged, but still surviving among some of the more primitive and isolated of these tribes, such as for instance the Kadars of the Perambiculam hills of Cochin and the adjoining hills of Coimbatore and Travancore and the Irulas and Paniyans of Wynaad among whom the presence of spirally curved hair has been found In the majority of cases the skin colour is dark chocolate brown approaching black, and the nose is very flat and broad, and not infrequently the lips are everted Some amount of agglutinogen tests have been taken on these tribes, such as the Kanikars, the Panyans and the Chenchus, which disclose a greater percentage of A over B with high frequency of 0

The people of this zone are undoubtedly the most primitive of the aboriginal population of India They have abandoned their original languages and now speak corrupt forms of Tamil, Telugu, Malayali and Kanarese The basis of their tribal life has centred round hunting and food gathering in a state of semi nomadism Agriculture was unknown in any form and the sole implements for digging roots and tubers were a bill-hook and digging stick Weapons of any kind, even bows and arrows hardly existed and life depended on forest products, collection of honey and fruits of the chase Fire was made by friction or by a drill, and originally they wore aprons made of leaves or grass skirts The source of authority rested in the village headman who adjudicated disputes and performed the rituals of the hunt The structure of society was largely on a matriarchal basis and among tribes on the Western Coast there is evidence of Polyandry, which is most marked among the Nilgiri Hill tribes, who form a distinct corporate unit with the pastoral Toda as the centre

In the Central Zone on the other hand, the Negrito strain is not marked The tribes very largely conform to the pattern of what are called "Australoid" characters, such as dark skin colour, short stature, long head with marked development of the lower forehead and very sunken nose at the root The nose is also fleshy and broad but the tip of the nose is moderately high and there is frequently a forward projection of the facial parts Unlike, however, the typical Australian, the hair either on the face or the body is not profuse Among these tribes in general there is a marked preponderance of the blood group B and less of 0

Except in a few cases these tribes have retained their original languages belonging to the 'Austric' family and to the branch which was first isolated by Frederich Muller in 1852 and named by him 'Munda'

These languages are agglutinative with extraordinary development of suffixes and prefixes There is no real verb and objects are not distinguished on their genders but according as they are animate or inanimate

The tribes living in the central belt are of a higher stage of culture Instead of the typical food gatherers' life, shifting cultivation is the prevalent form of food production Among them the houses are more solidly built and life is more settled with considerable development of arts and crafts, such as basketry, wood carving and implements of different kinds Communal life is better organized with village councils under a headman Among the more advanced sections, such as the Santals, there are in addition, a "Dihri" or district council and a supreme council of the tribe known as the "Hunt Council" The chief characteristic feature of their social life is the presence of bachelors' dormitories or Dhumkaria, with either separate dormitories for boys and girls, or, as among the Muria of Bastar, the Ghotul, shared by both boys and girls together, of which my esteemed colleague, Dr Verrier Elwin has recently published a remarkable account

Among these tribes, folk dancing and music are popular and there is a considerable development of poetry and song

Contact with the Indian people has been greatest among these tribes and there has undoubtedly been considerable infiltration of Indian ideas and religious rites

With regard to the North-Eastern Zone, the tribes show characteristic Mongoloid characters They are in general medium statured with brown to light brown skin colour and dark hair and eyes The cheek bones are prominent and the face flat The nose is fairly long but flat and low and not sunken at the root The forehead is smooth and there is hardly any development of the superciliary ridges The head is fairly broad but not flat at the back and shows the characteristics of the long headed rather than brachycephalic races What little agglutinogen tests have been taken, show that the blood groups A and B are present in fairly equal proportions indicating a pattern more in line with what we know of the Tibetan people

All these tribes speak languages belonging to the Tibeto-Burman branch of the Tibet Chinese family excepting the Khasi who speak a Monkhmer language of the Austric family The languages of the North Assam tribes, such as those of the Aka, Dafla, Miri and Abor, show however some influence of Indo Aryan tongues, and that of the Abor which is being now investigated by the Department of Anthropology, both in the structure of the grammar and vocabulary Indo Aryan influence seems to be quite marked thus distinguishing it from the Bodo and Naga group of languages

In these groups of tribes, the people who constitute the inner ring and dwell principally on the Central Massif, show a substratum of Megalithic culture with pronounced development of matriarchy Among the Rabhas, Mikirs and Kacharis, evidence of matriarchy still persists, but among the Garos and Khasis it exists in its full development and the position of women is at its highest

The groups living on the outer fringes have the entire organization of the tribal life built on the war basis, with villages built on high mountain spurs, surrounded by bamboo palisades or strong stone stockades and flanked by chutes This is specially prominent among the Naga tribes, who unlike the North Assam tribes practise head hunting The houses are solidly built on piles and among the Nagas they are chiefly of a communal character Shifting cultivation is chiefly resorted to, and Jhuming is practised on high mountain spurs among the North Assam tribes Terracing has made rapid progress among the Nagas There is a great development of arts and crafts, and weaving is practised largely among the Abors and allied tribes, who also grow their own cotton, spin the thread and weave beautiful clothes including the well known Abor rugs

Like the Central Indian tribes, one of their characteristic features, is the part played by the bachelors' dormitories in the village life of the tribe They have separate dormitories for boys called 'Moshup' or 'Morung' and 'Rasheng's for girls These institutions organize and control the entire youth of the village and help to develop them as fully trained members of the tribe with a thorough acquaintance with the defensive and offensive organizations of the tribe Art and Music and folk dances are highly developed and whose wonderful rhythm has to be seen to believe They are physically strong, healthy and full of the joy and vigour of life with democratic councils and considerable stress on personal liberty of thought and action They have child like simplicity and very honest but not trained for sustained labour and concentration of mind

The philosophy of their religion is the belief that life matter can be transferred to living organisms and material substances deficient in vitality This belief, as shown by Dr Hutton, is at the bottom of the Naga custom of head hunting, which fortunately does not occur among the North Assam tribes, but is widely practised from Assam to Oceania

What is the place of these 20 million and odd aboriginal people in the Indian nation and what part are they going to play in its future life ?

In the past, in those parts of the world where primitive tribes lived and later brought into contact with the civilized man, the results have not been very happy They were conquered, dispossessed of their lands, their tribal life disintegrated and were either brought under servitude or partially exterminated To give only the most striking examples, the once proud and war like Red Indian tribes of North America, living in Tipis and hunting the bison on horseback, were reduced to about one quarter of their total estimated strength The figures published by the Bureau of Census of the U S A show a total reduction from the round figure of nine lacs of people in 1860 to 237,000 in 1900 [1] In Melanesia, Polynesia and New Zealand the situation was similar In Australia the fate of the aboriginal population was even worse—they were virtually wiped out and are now confined to a few straggling bands in the central waste lands and deserts From an estimated population of 7,000, the native Tasmanians were reduced to 120 persons in 1764, and soon after 1864 the last of that race passed away leaving a sad commentary on the white man's solicitude for the aboriginal [1]

In this country although no wholesale extermination took place, they were mostly driven out to the hills and forests and partly absorbed The wilder sections of the tribes, however, living outside the limits of the contact zones, though not uninfluenced by Indian thoughts and ideas, were able to retain their tribal integrity undisturbed With the British occupation and rapid opening up of the Country they came closely in contact with the civilized Indian, from whom, it is regrettable to say, they did not always receive a square deal Several uprisings of the tribal people took place beginning from Mal Paharia rising in 1772, the mutiny of the Hos of Singbhum in 1831, the Khond uprising in 1846, to the Santal rebellion of 1855 In like manner a punitive expedition was sent to the Jaintia Hills in 1774, and in 1833 the Confederacy of the Khasi Chiefs was defeated by the British army Other expeditions were sent, such as those to Chin-Lushai Hills between

1850-1890, the Naga Hills expedition of 1878, the Abor expedition of 1912 and finally the column sent to the unadministered areas of the Naga Hills as late as 1936

The underlying causes of these uprisings were the deep dissatisfaction created among the tribal people against exploitation by their more advanced neighbours and resentment against violation of their native customs and rites Following the measures taken principally in the U S A after the initial stage of exploitation was over, to segregate the tribes into special areas of reservations to protect their lives and interests, the Government of India passed an Act in 1874 to specify the tribal areas into "Scheduled Tracts" These areas were reconstituted under Section 52 A of the Government of India Act of 1919, and finally in 1935 more stringent provisions for special treatment of tribal areas were incorporated by converting them into *total* and *partially excluded areas*

There is no doubt that these special measures gave the aboriginal tribes considerable amount of protection against exploitation and helped to allay their feeling of resentment and hostility to sudden and large scale encroachments on their land and disregard of their social and religious institutions

But it must be remembered that a negative policy of segregation, though essential in the early stages, is not enough In this view, I know, I am going against the opinion of such experienced administrators as Hutton and Grigson, who spent many years of their lives among primitive tribes and whose knowledge about their customs and genuine love for them cannot be questioned For students of human civilization and history, however, it is impossible to advocate segregation as a lasting policy of administration For complete isolation has never led to progress and advancement, but always to stagnation and death In every part of the world such has been the case From the aborigines of Australia to the Aryan speaking Khalash and Kati tribes of the Rambur and Bamboret Valleys of Chitral, it has been amply demonstrated that isolation can never lead to progress On the other hand, civilization everywhere has been built up by the contact and intercourse of peoples which has been the chief motivating power behind progress

There are innumerable instances of the borrowing of cultural traits by peoples of different countries, such as articles of food, use of metals, domestication of animals, methods of agriculture, spread of the alphabet etc So long as the borrowing is natural and in harmony with the cultural setting and psychological make up of the people, it has been entirely beneficial and even added to the richness of the culture The hill tribes of Assam for example, from times immemorial tilled their soil with digging stick and hoe and never learnt plough cultivation from the people of the plains As soon however as terraced cultivation was introduced, it spread rapidly, for terracing not only suited the hilly nature of the country but it could be performed with the implements they were accustomed to

The danger, however, of contact lies when it is sudden and indiscriminate and tends to upset the tribal life by forced measures on unwilling people, as the tragic history of the aboriginal peoples of Australia, Melanesia and the U S A has shown It follows, therefore, that just as isolation cannot be the ultimate solution of the aboriginal problem, so cannot be indiscriminate and unregulated contact A policy has to be devised which will ensure complete protection to tribal life and customs, but at the same time give the tribes an opportunity to be gradually integrated into the larger life of the nation In Australia and South Africa, where the white racial doctrine exists, isolation of the aboriginal people may be the policy of the Government, but such cannot be the case in India where they form part and parcel of our life It must however be remembered, that there can be no unitary pattern of national life with one mode of thought and living, to which every tribe must mould its life The gorgeousness of tribal life with all its vitality, colour, joy and enjoyment, must find its place if we are to assimilate them among us We must recognize other values of life which have for ages past given the aboriginals a healthy, vigorous life, and should not think of substituting them for a life of emasculation and stagnation On the other hand, the joy and merriment which now abound the hills, should be imbibed by us in our own life marked by asceticism and negation High philosophy and moral principles can never take the place of simple, chaste and scrupulously honest life of these primitive folks In a country imbued with the lofty ideals and humanism of Mahatma Gandhi, the aboriginal population must receive a square deal from their more advanced countrymen, and greater understanding and sympathy for their mode of life and thought, so that they do not feel themselves as aliens, but as full citizens of the same country with their interests closely interwoven with the rest, for good or bad The fostering of the growth of a common outlook and common interest should be the ideal for which both should strive In short, the administration of primitive tribes should be so planned that this purpose is served by helping to develop them on their own models and thought, and fitting them gradually as full and integral members of the country and participating like the rest in her joys and sorrows

POWER DEVELOPMENT WITH NUCLEAR ENERGY

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[*Continued from Previous issue*]

Design Problems

For efficient working of such a plant there are many technical difficulties to be solved. The graphite and uranium shall have to be extremely pure, and shall have to be free from elements which swallow neutrons unproductively such as boron, boron is so widely spread that it is a serious problem to free uranium from it The manufacture and fabrication into thin aluminium sheathed rods of uranium of the necessary super quality is an extremely difficult metallurgical problem For aluminium sheathing the temperature is limited by the safe stress it can withstand without creeping The maximum exit gas temperature is of the order of 300 to 400°C For high thermal efficiencies, the sheaths have got to withstand higher temperature Further research is necessary and could only supply the material to replace aluminium for sheaths The coolant or heat transfer medium also presents difficult problems in its selection It must resist the intense neutron bombardment in the pile without reacting itself, otherwise it will lead to enormous radio active element production which is least desirable Heavy neutron absorption may lead to the stoppage of the chain reaction The amount of coolant hence introduced should be as little as possible to minimise the presence of neutron absorbing materials inside the pile The heat loads are again too high and the design of the cooling passages and arrangement of heating elements in the pile will involve advanced heat transfer technique The coolant should not be unduly corrosive and also should remain liquid at high temperature and at relatively low pressure Since this medium becomes extremely radioactive while flowing through the pile, operating difficulties are less encountered at low pressure and high temperature than handling such highly radioactive substance at high pressure and high temperature

This equipment will handle highly radioactive fluid and therefore the whole heat transfer system must be enclosed within heavy shielding In the event of any leak into the steam side of the heat exchanger the radioactive materials would contaminate the steam system, and a leak from the steam side into the radioactive side may disturb the very delicate operating conditions of the pile

Pumps for circulating coolant The pumps have to handle radioactive fluid and therefore remote operation is necessary The design itself of the pump system is the normal one, either one stage or multiple pump stages, with stand-bys if the main system fails.

The high level of radiation and the high working temperature of the units cause thermal expansion of the various parts and tolerances have to be proportionately made in the shield design The shields themselves might undergo thermal expansion, as the dissipation of radiation would turn into heat A number of holes are provided in the shielding, for process tubes, controls, and so on, and each of these holes must be properly shielded against leakage of radiation

Instrumentation Instruments will have to be installed to show power level, neutron intensity, and other major operating variables, and to indicate troubles, if any The operating power level of the pile can be measured by an ionization chamber to measure the neutron flux, or by a thermometer to measure the heat developed Indicators of this type have to be connected through relays to operate safety devices, such as rods containing a strong neutron absorber like boron, these rods may be driven quickly into the pile by springs or compressed air at any prefixed level of power

When the pile is working, there will be enormous α, β, γ and neutron radiation, and all these radiations will effect the human tissues To assure that the workers are not absorbing radiation more than the 'Tolerence Dose' each worker must be provided with health instrument, radiation meter and photographic film in their uniforms

TABLE II

Knolls Atomic Power Laboratory Maximum Permissible Daily Exposure Limits to Radiation

Type of Radiation	Roentgens	Rep	Rem
X Ray	0 1	0 1	0 1
Gamma	0 1	0 1	0 1
Beta	—	0 1	0 1
Fast neutrons	—	0 02	0 1
Thermal neutrons	—	0 02–0 10	0 1
Alpha*	—	0 1	0 1

* Considered from the standpoint of internal effects only

The separation of plutonium from natural uranium is a difficult chemical engineering problem and has to be carried out by remote control mechanisms The process involved in remaking uranium after extraction of fission products is shown in the flow sheet (Fig 7) The flow sheet further indicates the sequence of processes whereby energy of nuclear fission can be released and converted into electrical energy There are two kinds of atomic piles introduced in the flow sheet, primary piles running on uranium, and secondary piles using plutonium or thorium synthesised in the primary pile In the selection of site for any power plant climate, maintenance facilities, availablity of good

water supply, soil, transportation are important factors contributing to it, similarly a very important

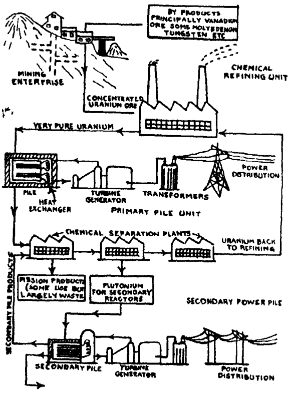

FIG: 7 REMAKING OF URANIUM
[FROM P.I.Mech.E.]

requirement to operate a pile is, that, the site must be free from earth quake shocks and floods The high original costs will heavily weigh against installation to serve small or sporadic demands

Economic Aspect of Nuclear Power

There is very little information at present which can be thrown upon the problem from the economical aspect, and the feasibility of the plant which are very important considerations for an engineer While the British Engineers think, it is too early to guess and hint upon the economical aspect, the Americans who have made considerable progress in the field have given some ideas to that effect The difficulty, however, is, that, whereas in some cases estimates have been made from datas which are in the possession of Americans, and where none is available the calculations are based on assumptions highly controversial

An estimate of Prof J R Menke which is somewhat reliable is summarised below Here again the whole estimate should be taken as a first approximation in view of the future developments when many problems which control the present day high cost will have been solved making the plant an economic proposition

As mentioned, when 1 lb of U235 in an atomic pile undergoes nuclear fission the yields are estimated at about 10 million kWhrs of heat/lb of U235 or Plutonium fissioned since about 200 million electron volts of energy are released in every fission Fissile elements like plutonium from U238, and U233 from thorium, if it is assumed that of the three neutrons set free per fission one is going to continue the chain reaction and the other for conversion of U238 and thorium, yield about 1 lb of new fissile element for each lb of U235 burnt, and roughly one lb of new radioactive element

The effect of atomic energy on the cost of power can be examined by considering the present cost of power and its variation with coal price and the anticipated cost of nuclear power It will be convenient to consider the cost to the generating plant of the

TABLE III

Bus bar Cost of Coal steam Power Plant
(Typical of better Plant) 1944

Cents per kilo watt hour

	Load Factor=0 5	Load Factor=1 0
I DIRECT COSTS		
(a) Fuel cost at mine 0 12+ transport and handling	0 3	0 3
(b) Labour	0 05	0 05
(c) Maintenance and other supplies	0 04	0 04
	0 39	0 39
II FIXED COSTS		
(a) Overhead administrative and general	0 06	0 03
(b) Taxes (& Franchise costs)	0 13	0 065
(c) Interest	0 08	0 08
(d) Depreciation (& reserves for obsolescence)	0 08	0 04
(e) Insurance	0 01	0 005
	0 36	0 18
Total Cents/kWhr	0 75	0 57

Assumptions
1 Plant investment = $ 120 per kW of capacity
2 Thermal efficiency =0 26=(1 lb of coal/kWhr)
3 Coal price = $ 6/ton delivered
4 Fixed cost total =12% of plant investment
5 Correction for power factor of 0 9 has been made

electric power produced 'at bus-bars' which means the cost of generating station, both fixed and direct The costs of transmission, distribution and consumer

relations are not considered, these latter categories represent about 2/3 of the domestic consumers bill

Datas available to compare the cost of electric power at the bus bar indicate that the coal steam electric power costs from 0 4 to 1 5 cents per kWhr in representative thermal plants in the U S A , and, hydro electric power systems from 0 4 to 0 05 cents per kWhr Sales revenues for both systems in United States for 1940 44 averaged between 1 7 and 1 5 cents per kWhr The difference is represented mostly by the distribution costs Large consumers pay very little more than the bus-bar costs for power The table below represents values for an efficient (thermal) plant running at a higher than average load factor The national average for thermal efficiency was 0 21 in 1940, and 0 44 for load factor in the same year These values were chosen in order to compare the better present practice with new development

Thus for 0 5 Load factor fuel represents 40% of the total bus bar cost and for the same plant at (unity) Load factor fuel represents 50% of the total Fuel costs may vary from $4 to $12 per ton depending on the remoteness of localities from sources The effect of different coal price on power is as follows

TABLE IV

COST OF POWER IN CENTS PER KILO WATT HOUR WITH DIFFERENT COAL PRICES

Coal price	Load factor = 0 5	Load factor = 1 0
$ 4 per ton	0 65	0 47
,, 6 ,,	0 75	0 57
,, 8 ,,	0 85	0 67
,, 10 ,,	0 95	0 77
,, 12 ,,	1 05	0 87

N B The calculation has been based using the same assumption as in table I

From the similarity of the use of heat, from the pile and from the coal furnace, estimation of the cost of operation and maintenance of that part of the pile system based on published data on steam power plants is computed

Nuclear Power Cost

For calculating the lower limit to the cost of pile power, to make a first approximation it is assumed,

(a) The pile replenishes itself,

(b) Purification cost is negligible, i e , fuel cost is zero;

(c) Capital and other operating costs are similar to those of the thermal plants,

the total power cost will be reduced by a figure value which lies between the hydro electric and fuel plant costs as shown below

TABLE V

Rough comparison of Power Costs	cents/kWhr
1 Hydro	0 4—0 05
2 Nuclear (first approximation)	0 5—0 3
3 Coal steam	0 4—1 5

Let us examine a breakdown of probable costs of a plant of 100,000kW It is assumed that the fuel costs will occur only as fixed charges on the original investment

TABLE VI

COST OF NUCLEAR FUEL

Concentration	Pounds of metal in U S	Cost/lb of metal
1 0% and higher	10^7	—
0 1%	10^8	$ 5
0 01%	10^9	$ 50
0 001%	10^{10}	$ 500

The cost of all purification and reprocessing is estimated at 0 1 cent/kWhr in an arbitrary manner The cost of all equipment except the pile itself might be estimated from data on the cost of steam electric plants On the same basis as before, on $ 120 per kW capacity, and remembering that the expense of the furnace is saved, (about 25% of total plant up to the bus bar) then for such a plant we have 0 75 × $ 120/kW = $90/kW

It is difficult to estimate the cost of the pile with its present day fissile charge While the cost of present day piles is much higher, in a study entitled "Nuclear Energy Potentialities" by Wagner and Hutcheson of the Westinghouse Electric Corporation, they give two estimates to indicate the probable range $60 per kW and $120 per kW respectively Taking the more conservative figure, investment of about $ 120 + $90 = $210 per kW of electric capacity Then the fixed charge cost per kWhr can be estimated by using the overall fixed percentage developed previously, about 12%

To this fixed cost may be added an allowance for labour and maintenance similar to that given previously equal to about 0 09 cent per kWhr, so that the total estimated cost comes as shown in table VII

It will be noted that almost one half of the total cost is represented by fixed costs on fissile materials As this investment cost becomes less and less, owing to improvements in the synthesizing and separating

process, this item in the power cost will be reduced, and a figure of 0 3 cents/kWhr might be achieved in near future

TABLE VII

NUCLEAR POWER COST
(Near future, say 5–10 years)

	Cents/kWhr Load factor=0 5	Load factor=1 0
I DIRECT COSTS		
Labour, maintenance	0 09	0 09
Reprocessing costs	0 10	0 10
II FIXED COSTS		
Fissionable materials in Pile	0 34	0 17
Auxiliary and secondary machinery	0 24	0 12
Total	0 77	0 48

Effect of the fission fragments yielded from Nuclear reaction in the pile upon the cost of Nuclear Power cannot be asserted at the present moment If, for instance, the problem of photosynthesis of organics can be solved with radio tracers as tools of reasearch, then the available amount of food and energy can be increased enormously while these radio elements have enormous usefulness as research tools in many other fields, as it is not likely that they will quickly become products of economic importance in themselves

Effect of production of new fissile elements in the atomic pile upon the cost of Nuclear Power has a good bearing since the availability of Nuclear fuel is extremely limited

ADVANTAGES OF NUCLEAR POWER OVER STEAM OR HYDRO

It appears unlikely that uranium will substitute coal, coal will still retain its importance as a fuel for large scale industrial use But, the enormous convenience of handling such a conentrated fuel cannot be but over emphasised Localities remote from water power and cheap coal can be supplied with power The emancipation from the problem of transporting fuels in bulk is tempting enough for pile installations

One British scientist-engineer thinks if a large air port near the north pole can be opened it would shorten enormously many important air routes, another Mexican scientist thinks that in places where thousands of acres of agricultural land are lying untilled on one side of a steep cliff, and on the other side of the cliff lies vast resources of water Only a pump is required to turn the barren fields into rich green fertile lands Since steam or hydro-electric power is not within easy reach, if use of atomic energy as a source of power becomes an economic proposition, those parts will swim in plenty of green crops Any way there are prospects for atomic power if its generation becomes economic Industries will flourish in places where there are raw materials but no source of generating natural power is available

ADVANCES MADE SO FAR

These atomic power plants are now under operation, at Oak Ridge, Tenn , Chicago, Illinois, and Schenectady, N Y , and, according to Dr Condon, Director of the National Bureau of Standards, it should be possible to realise experimental production of power within a year or two Major atomic energy problems are being carried out in U S A at a number of places

In Britain, the first atomic pile GLEEP (Graphite Low Energy Experimental Pile) was completed in August 1947 It develops 100 kW of nuclear energy The second pile BEPO (British Experimental Pile) was started on July 3, 1948 It develops 6000 kW nuclear energy Production of pure graphite, uranium, and fabricated aluminium encased uranium rods have also been developed At a number of other places various other atomic energy problems are investigated

Very little information has been made public about atomic developments in Russia A large number of scientific personnel is engaged in this research in the Academy of Sciences, but no information is disclosed In 1942 A E Brodsky separated U235 by thermal diffusion at the Dnieperpetrovsk Power Plant, but concluded that the power consumed in the process rendered this process impossible They claim that the process of atomic fission is no more a secret to them

France, Switzerland and Sweden are also carrying out work on this problem in a very modest way

INDIAN PHARMACOPOEIA

THE *Indian Pharmacopoeia List* was first published in 1946, and it will be revised soon It is very disappointing to say that it is a poor compilation from the existing sources The methods of assay of drugs in most cases were unfortunately not standardized by the Drugs Technical Advisory Board, and in some cases the methods do not lead to definite conclusions A cursory glance through the pages has revealed plenty of discrepancies, which are worth noticing It is expected that these will be removed in the revised edition of the Pharmacopoeia

To cite a few examples, on page 9, for the assay of areca nut, in the fifth line, "Allow to settle and decant the ether into another flask *Wash with ether*" What shall we wash with ether? This part is ambiguous, and needs to be rewritten In the eighth line again, "Decant 50 ml of the ether" Obviously an analyst will ask what is the 50 ml ether solution equivalent to ? We mean how many grams of areca?

On page 11, the assay of Artemisia is described There in the twentyfourth line, "to the weight found add 0 04 gm *for the santonin* dissolved in the *dilute alcohol multiply the total by 10 to obtain the percentage of santonin*" The part of the sentence in italics conveys no meaning at all The Chopra Committee has unfortunately overlooked the simple rule of solution, the volume of the solvent, the temperature and the strength of the solvent *viz*, the percentage of alcohol in the *dilute* alcohol need *must* be mentioned, otherwise adding 0 04 gm is absolutely meaningless

On page 15, the fourth line of the assay of Berberis, "Precipitate 30 ml of the ethereal extract (equivalent to 1 gm of the bark) with 5 ml of a solution of picrolonic acid, *dry and weigh*" The strength of the picrolonic acid solution has not been mentioned And should one dry and weigh the whole solution? The original method described by Ripert (1914) states that the precipitate of picrolonate was filtered and well washed with ether to remove excess of picrolonic acid and then dried and finally weighed It seems that the Chopra Committee did not care to go through the pages of the Pharmacopoeia before its publication

Page 83, "Dissolve one drop (of oil of cassia) in 5 ml of alcohol (90 percent) and one drop of solution of ferric chloride, a blue or deep brown colour is produced"

Conforms with the requirements of the test for heavy metals in volatile oils" These sentences give us the tests for identity and purity of the oil of cassia The sentence in italics is rather abrupt and conveys no sense

Tests for Purity again on page 91. These are for shark liver oil. They read like this.

"Acid value not greater than 2 Saponification value not greater than 200 etc" If the least limiting values are not mentioned, the standard of purity can not be set from the above data

An unqualified statement on page 101, "By treating 1 ml of *standard copper sulphate solution* in 15 ml of water" Unless the strength of the standard solution is given, it is absolutely meaningless

The molecular weight of 5 chloro 7 iodo-8 hydroxy-quinoline, $C_9H_4N(OH)$ I Cl is never 269 4, as has been mentioned on page 107 but is always 305 5 Now for the calculation for iodine and chlorine contents of the above compound, a simpler method may be suggested for the existing unintelligible one, on page 108 Let x be the weight of silver iodide, $(w\ x)$ the weight of silver chloride, and W, the weight of the sample of 5 chloro 7 iodo 8 hydroxy quinoline taken.

1 gm of AgI = 5404 gm iodine

$$\text{p c of iodine in the sample} = \frac{x \times 5404 \times 100}{W}$$

Since 1 gm of AgCl = 2474 gm chlorine

$$\text{p c of chlorine in the sample} = \frac{(w-x) \times 2474 \times 100}{W}$$

Page 122 deals with an important substance, thyroid, the assay is given in best of details, and it is a line by line copy of the assay method given in B P ! Unfortunately the Indian Pharmacopoeia has dropped an important line, after "Cool to about 20°, (*Vide* the thirteenth line from top in the Indian Pharmacopoeia, on page 123), which reads thus in B P "Add 0 2 ml of a 25 per cent w/v solution of phenol in glacial acetic acid" A sad failure indeed, to copy the method even correctly !

The *Indian Pharmacist* (December 1948) has already remarked on the recent formation of the Indian Pharmacopoeia Committee, "The procedure followed in the constitution of the above Committee has neither been democratic after the United States pattern nor semi-democratic as per the U K model" According to the *Indian Pharmacist*, "the Committee appointed by the Government is manned mostly by administrators and no attempt has been made to make it a representative body or to include persons with special knowledge of various subjects By following the undemocratic method, the Ministry of Health has exposed itself to the charge of favouritism and patronage" If the above statement of the *Indian Pharmacist* is not without foundation, the reason for all these grave omission and commission in the *Indian Pharmacopoeia*, is not far to seek

It is deplorable that mistakes which could have been easily removed if one would care to go through old literature a little more closely, have also crept in the book which led eventually to the compilation of Indian Pharmacopoeia. We mean Chopra's Indigenous Drugs of India, published in 1933. To mention one or two wrong information on botanical matters, Chopra writes on page 67, "Not only plants (*Atropa belladonna*) in all stages of growth have been collected *but a variety known as lutescens with a low alkaloid content has frequently been substituted*. A large portion of the wild Indian belladonna exported to England of late years, *consists of the lutescens variety*." If the author would have cared to look up the *Journal of the Linnaean Society* (1881), *38*, page 82, where Aitchison used the name *A. lutescens* of Jacquemont for the Indian species of *A. belladonna*, which of course now-a-days is called *A. belladonna* var *acuminata* R. Chatterjee *et* J. K. Lahiri. Even if he would not have gone for the Journal, he would have even got the same information from the standard book of reference on Indian botany, Hooker's Flora of British India, 1885, Vol 4, page 241, where Clarke mentioned *A. lutescens* Jacquemont and *A. acuminata* Royle, were synonyms for *A. belladonna* Linn., the Indian belladonna. So we must say that Chopra's statement quoted above is erroneous.

Again for the nomenclature of the so called *Datura fastuosa* (page 128), he has given all antiquated information which are no longer in use. Maries (1890) had remarked that there is no such thing as *D. metel* as distinguished from *D. fastuosa* in the herbarium collection in India. Cooke (1908) did not recognise *D. fastuosa* var alba, and reduced it to *D. fastuosa*. Watt (1890) mentioned that *D. metel* could with difficulty be distinguished from *D. fastuosa*, and Prain was also of the same opinion. In short *D. fastuosa* is called *D. metel* and the so-called black and white varieties of *D. fastuosa* are not recognised. Still Chopra persists in calling it *D. fastuosa*, when Safford as early as 1921 accepted the name *D. metel* of Linnaeus for the variable Indian plant, and reduced *D. fastuosa* to the rank of synonym under the name of *D. metel*.

Chopra calls the Indian Podophyllum (page 228), as *P. emodi*, and on the table on page 230, refers to the resin content of Podophyllum from different districts of North India. Does he know that the Podophyllum of Northern India was called by Royle as *P. hexandrum* and the British Pharmacopoeia also calls it *P. hexandrum* Royle? If Chopra would have compared the species of Podophyllum collected from Nepal (the true *P. emodi*) by Wallich with that from Kashmir and other parts of North India, he would have observed the morphological differences and would have corrected his statement.

Of the berberine containing plants (page 294) Chopra mentions one *Berberis nepalensis*. We wonder why he has not corrected the old name and put the more recent name *Mahonia acanthifolia* or the like. Considering the range of localities where the plant grows, it has changed its morphological characters considerably to call it a single species. For instance in the Assam side, five species of *Mahonia* grow, in the Nilgiri, only one, *M. Leschenaultii*, in the Dehra Dun side *M. borealis* and so on. Such a sweeping statement as, "It (*B. nepalensis*) grows commonly on the outer Himalayas, from the Ravi eastward to Khasia and the Naga Hills and also in the Nilgiris—", is not in keeping with an authoritative book of an illustrious writer. These findings on *Mahonia* were published by Takeda (1911-17), and Chopra's book was published in 1933!

R. G. C.

TITANIUM IN TRAVANCORE

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THOUGH Titanium was discovered by Gregor as early as 1798, for many years this element was considered rare This was because it occurs in nature almost always in tenacious combination with other elements, chiefly iron and its separation and purification is comparatively difficult The metal and its compounds have, however, been studied in recent years and it is now estimated that Titanium is more plentiful in the earth's crust than nickel, copper or zinc

The idea of using titanium-di oxide as a pigment was first suggested by Dr A J Rossi, a French scientist in the early nineties of the last century Today Titanium-di-oxide is one of the whitest substances known, reputed for its great brilliance, opacity and durability

The Titanium industry recorded rapid development between 1930 and 1940 The chief commercial sources of Titanium are ilmenite and rutile, the greatest demand on the industry coming from the pigment trade In 1930 the United States of America, the leading consumer, imported a little over 20,000 short tons of titanium minerals, in ten years' time this had increased to over 200,000 tons, the principal supplies of which came from Travancore The first trial consignment of ilmenite was shipped by Travancore Minerals Company in 1922 and the peak year was 1940 Further continued expansion in the production and export of ilmenite, however, was arrested by circumstances created by the World War II, such as paucity of shipping space and the introduction of priority schedules

Ilmenite is an iron-black mineral with a sub metallic lustre, essentially a ferrous titanate but of variable composition, ferric oxide often partly replacing the titanium di-oxide The composition of ilmenite is further complicated by inter crystalline growth of ilmenite and magnetite The percentage content of titanium di oxide averaged by ilmenite from the various sources of the World are

Norway	42 to 43
Brazil	52 to 53
Roseland, Va, U S A	54
Piny River, Va, U S A	48 to 50
Mac Intyre, N Y, U S A	46

as compared to Manavalakurichi, Travancore, 54 and Neendakara, Travancore 59 to 60 The production of ilmenite from the richer beds of Neendakara commenced about ten years after ilmenite was first worked at Manavalakurichi As a result of the continued demand for the richer variety the production at Manavalakurichi gradually dwindled and finally stopped

The composition of typical beach deposits worked for the production of ilmenite may approximately be given as follows —

	Manavalakurichi %	*Neendakara* %
Ilmenite	75 to 80	round 60
Zircon	4 to 6	4 to 6
Sillimanite	2 to 4	3 to 5
Rutile	3 to 5	4 to 6
Garnet	3 to 5	less than ½
Silica	5 to 7	4 to 5
Monazite	round 1	½ to 1
Other minerals	of the order of 0 1 percent or less	

The deposits are therefore a mixture of mineral sands varying in specific gravity from that of silica, 2 3 to that of monazite, 4 9 These minerals were originally disseminated in the body of the igneous rocks of the hinterlands and the Ghats The rocks are subjected to the continuous pounding and leaching action of all the forces of nature, in certain regions these rocks have yielded laterites and laterite clay as typified in the red hills of Muttam, in certain others the rocks have been altered into sandstones as seen at Varkala But in all this metamorphosis, the unaffected minerals released from the rocks find their way to the lowlands and finally to the sea coast carried by monsoon torrents The difficult task of crushing, milling and classification has therefore been accomplished by the perennial work of nature and the sorting action of the tides and waves of the sea The deposits are the continued accumulation of minerals of homogeneous identity and more or less of uniform grain size, ready to be fed to a dressing plant

Ilmenite is separated by magnetic concentration The sun dried mined material is first run through a 30 mesh vibrating screen to remove limeshells and other trash The material passing through the screen is fed to the hoppers of electromagnetic separators of the 'lift' type, of which the Whetherill machine is a standard example In this machine the sand is carried in a thin layer with moderate speed on a wide belt which passes successively through four magnetic fields at each of which cross belts running perpendicular to the feed belt pick up the ilmenite and discharge it into bins whence it is collected and bagged Two important factors govern this process of concentration One—minimum entrainment or picking up of impurities along with ilmenite, and two—maximum recovery of ilmenite from the feeds consistent with its purity After studying the properties of Travancore ilmenite and the impurites from which it has to be separated, Messrs Travancore Minerals Company have evolved the 'Deflift' Electromagnetic Separator,* a number of which have been constructed by them using local materials and employing local labour By careful adjustments and control it is possible to recover 60 per cent of the ilmenite contained in the feeds, in one operation

* Patent registered in Travancore.

The composition of ilmenite concentrated in this manner is given below —

	Manavalakurichi %	*Neendakara* %
Ilmenite	91 to 93	round 98
Zircon	1 to 2	round 1
Sillimanite	less than ½	less than ½
Garnet	3 to 5	less than ½
Rutile	about ½	less than ½
Silica	less than ½	less than ½
Monazite	round ½	round ½

Owing to the incidence of higher percentage of garnet in the Manavalakurichi sands magnetic concentration alone is not sufficient for the production of shippable grades of ilmenite The magnetic concentrate has to be treated further on gravity tables to reduce the content of garnet to well below 2 per cent Such a second treatment is unnecessary with Neendakara sands This aspect of the concentration is another advantage in favour of the Neendakara variety

The recovery of the residual ilmenite forms part of the process of the concentration and production of the other minerals namely, zircon, rutile, sillimanite and monazite

Rutile, the other important source of Titanium, is also usually black like ilmenite but sometimes occurs in various shades of brown, orange and red It is the natural form of titanium-di oxide, the other forms being Brookite and Anatase Rutile is much rarer than ilmenite and more difficult to concentrate

The production of rutile in Travancore commenced only in recent years The first concentrates of this mineral were produced by Travancore Minerals Company by what was very aptly described as 'bow and arrow' methods Rutile is very feebly magnetic When a mixture of the sands containing a fairly high percentage of rutile—say 40%—is run through a High Intensity Deflector of the Induced roll type, a very small fraction of the rutile passes into the magnetic fraction But this process proved to be too laborious to be economic Small consignments of the order of 3 and 5 tons, however, were made ready by this method after many weeks' laborious work

In 1938 Travancore Minerals Company installed their pilot plant for the production of rutile by Electrostatic concentration The ebonite rod, catskin and the pithballs commonly demonstrated in popular experiments in static electricity are now getting down to serious business The principle underlying this process of separation is the difference in the electrical conductivity of the materials which are to be sorted out A well sized feed is dropped in the form of a thin stream over a metallic roller, acting as a grounded electrode, in the field of a charged metal rod or neon gas tube. The particles become inductively charged, the more conductive material being repelled away from the falling stream due to its receiving a like charge of the electrode The concentration of rutile is accomplished in several treatments and this method, though far from perfect, is so far the most successful method of producing rutile

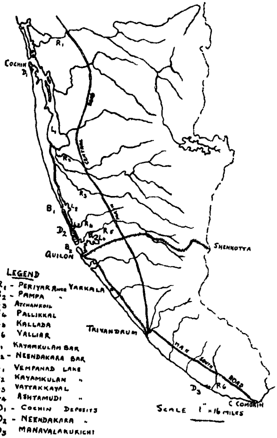
Great fillip was given to the production of rutile during the war years of 1940 to 1943 and Travancore was an important source of a reliably uniform grade of rutile A great demand arose for rutile for the manufacture of arc welding electrodes, unlimited supplies of which were needed in the building of ships, tanks and other weapons of war In the field of structural engineering of steel arc welding has in recent years displaced a great deal the time honoured process of riveting Post war years, however, have seen a dull in the demand for rutile, apparently because of the stocks strategically accumulated during the war years Other producers of rutile are Australia, Brazil and the United States of America

Pure Titanium metal is of silver grey colour and melts at 1800°C It has a very great affinity for oxygen, carbon and nitrogen and is therefore difficult to pre pare pure The metal has possible applications in such fields as aviation, automotive industry, maufacture of titanium alloys for cutting tools and dies and other special equipment calling for extreme hardness, high strength, light weight and acid resistance The chief commercial ore, ilmenite is used for the extraction of titanium di oxide, most of which is consumed in the pigment trade for the manufacture of white and light coloured paints It is also used in the making of paper, white rubber, leather, linoleum, ceramics and cosmetics Thin newsprint impregnated with titania imparts to it the most desirable properties of great opacity and lightness Superior covering power and brilliance coupled with its non toxic character places titanium pigments on a distinctly superior class both from the viewpoint of manufacture and its general use

Relatively smaller amounts of titanium are used up in the manufacture of the metal and alloys Titanium tetrachloride is used in the purification of aluminium alloys, in skywriting and as an ingredient of smoke screens An alloy of copper and titanium is used to purify copper castings to which it imparts a closegrain structure free form blast holes Other minor uses are in the delustering of rayon, tinting of artificial teeth and as mordants in the dyeing industry In fact it is very strange but true that some whitest of products are produced from the blackest of minerals

The largest producer of ilmenite in the United States of America today is the MacIntyre Works in the Adirondack mountains of New York District The ore is mined by blasting , and is crushed, milled and sized before being fed to Wet Magnetic Separators Workable concentrates of iron ore and ilmenite of fairly high TiO_2 content are produced This Mill is reported to have treated 1,300,000 short tons of ore in 1943 which yielded 170,000 tons of ilmenite In 1944 this ilmenite production increased to 220,000 tons and in 1945 it was 270,000 tons The Adirondack ore is ilmenite intermixed with vanadium-bearing magnetite, from which all the three metals are recovered Though highgrade iron ore is reported to be available in consi-

derable tonnages in several parts of the United States and Canada, the iron and the titanium minerals are so intimately interlocked that they cannot be separated by any known means of ore-dressing Iron ore containing over a critical percentage of titanium cannot be successfully smelted in the blast furnace Extensive research is now being carried out in the United States of America for evolving a method of working out such deposits to yield both iron and titanium



Map of Travancore

Other producers of ilmenite are Norway, Senegal, the Malay Peninsula and Australia In Japan rich concentrates of titaniferous magnetite sands, capable of yielding ilmenite giving 60 to 65 per cent TiO_2 are estimated at 10,000,000,000 tons, Ilmenite reserves of Russia in the Ilmenite Mountains are said to be about 400,000,000 tons

The reserves of Travancore sands containing titanium have not been accurately assessed so far This is a difficult task as the deposits are very widely distributed The beaches of Manvalakurichi where mining was confined to a small length do not appear to have been seriously depleted of the black sands; the beach deposits and the neighbouring dunes situated between the Neendakara and Kayankulam bars may be expected to hold at a conservative estimate 20,000,000 tons of mineral-bearing sands

A close examination of the extent of the mineral sands in relation to the geographical features* of the Neendakara region leads to a reasonable deduction that the minerals on the sea beach may have overflown the lake beds by the powerful action of the tides and the prevailing undercurrents The lake beds themselves have been a repository of minerals which have been brought down by the sedimentary action of streams and rivers particularly by the Kallada river It seems probable that the minerals collected at the lake bottoms are masked by the regular deposition of clay and silt—not to speak of submarine growths—also drained by the same natural agencies A careful investigation of the lake beds therefore may open up new reserves of minerals and perhaps even yield a different family of heavier minerals† which might have defied the migratory action of the tides The sea beds adjoining the beaches rich in minerals, may also contain appreciable quantities of minerals This is because during the months of heavy swells the deposits of black sands on the beach have been observed to increase in thickness without any sensible shift of the water line The sea, at such times, would be so turbulent as to hold almost all silica in continuous suspension Other possible sources of mineral sands are sea beaches adjoining river mouths

It would be very interesting indeed to investigate the disappearance of black sands north of Kayankulam bar The perennial waters draining the hinterlands and Ghats by the natural agencies of streams and river particularly the Pampa river and its tributaries do not get an immediate outlet into the sea in this part of Travancore Any minerals collected and drained by those agencies therefore would be thrown into the beds of the Vembanad lakes and lie perhaps hidden in the conglomerous mass of silt clay and shells The Kallada river and the Atchankoil river drain similar regions of the Ghats, when we find the Kallada river mouth in the Ashtamudi lakes yielding such vast deposits of minerals, is it unreasonable to expect that the rivers discharging their contents into the Vembanad lakes, also might have carried down their own charge of a similar variety?

A few years ago the Cochin Government made an announcement regarding the ilmenite deposits in that State which were said to contain 98 per cent ilmenite (*The Hindu 12*, 2, 1944) analysing about 20 per cent TiO_2 An examination and study of sands sampled from a fairly good length of the beach revealed that the ilmenite was contaminated with an almost equal amount of black hornblende, hardly distinguishable from ilmenite The Cochin sands were also noticed to contain a small percentage of magnetite not usually present in Travancore sands Following the analogy of the Travancore deposits, the Cochin sands were apparently derived from sources of a different type The deposits

*SCIENCE & CULTURE, *12*, 22, 1946

†Trace of Baddeleyite and Thorianite have been found in the beach.

may have been built up by the sedimentary action of the Periyar and its tributaries Both hornblende and magnetite were observed to be in the black sands collected from the bed of this river Certain local residents stated that iron used to be smelted by crude indigenous methods from a variety of magnetite obtained from the nearby mountains

Monazite which is present in certain regions of the beach owing to its high content of Thorium has attained a very unique status as a strategic mineral as a potential source of Atomic energy It may therefore be taken for granted that the authorities concerned would lose no time in undertaking a systematic investigation of the reserves of this precious mineral in India, particularly in Travancore, when a more systematic knowledge of the Titanium minerals also may be secured

USE OF POTATO CHIPS, EYES, AND SPROUTS AS SEED

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ALTHOUGH it was common knowledge that propagation of potatoes from small pieces of a whole tuber was possible under suitable conditions, its practical utilization was first taken up in the U S S R during the World War II War conditions made it necessary to increase the area under potatoes in the U S S R because they furnish more food and industrial raw material per acre than any other crop The supplies of seed, however, were insufficient to allow much expansion The shortage was overcome by using potato tops (a small piece with an eye cut from the rose end of the tuber, the piece being nearly 1/10th in size of the whole tuber) as seed and using the remaining portion (nearly 90%) for food or processing purposes The method was elaborated by Prof Lysenko and his coworkers at the Lenin All Union Agricultural Academy (*Anon*, 1942) In 1942 a total of nearly 3,80,000 acres were reported to have been planted with tops in various parts of the South east and Centre of the U S S R and the yields from the tops were not inferior to those of potatoes planted in the usual way, and in regions where ring rot is prevalent plants grown from tops were reported to be less liable to the disease than those from the seed The idea was carried still further by Prof Yakushkin of the Timiryazev Agricultural Academy, Moscow, who planted an eye itself with a small piece of flesh attached and obtained encouraging results (Garner, 1943)

Subsequently this line of work was undertaken elsewhere with a view to evaluating the suitability of this new method Evans (1943) in England found that whereas tops (1" in diameter, 1/14" in thickness at the thickest part, planted 12" apart in rows 2'-6" apart and at a depth of 2" to 3" in the soil) yielded 526 lb of tubers from 1/60th of an acre, the whole tubers yielded 613½ lb under similar conditions He calculated that only 3 cwt (nearly 4 md) of tops would be required to plant 1 acre against 13 cwt (17 18 md) of whole tubers Copisarow (1943) reported that 288 tops (each of ½" diameter, ¼ oz in weight, planted in boxes) from 24 lb of potatoes gave 804 tubers weighing 172 lb, each plant yielding nearly 10 oz Pal and Deshmukh (1944) conducted experiments in India They found that whereas 100 plants raised from whole tuber of *Phulwa* (each tuber approximately weighing 21 45 gm) yielded 51 5 lb, 100 plants raised from tops (each weighing 4 2 gm) yielded 33 4 lb, 100 plants raised from 'eyes', on the other hand, yielded only 18 7 lb As a result of these preliminary observations it was thought possible to improve the yields from tops under suitable spacing and manuring Accordingly an experiment initiated (Pal and Deshmukh, *unpublished work*) in 1944 45 with 3 spacing (1½'×6", 1'×6") and 3 manurial treatments (no manure, a manurial mixture before planting and the same after planting) was conducted for three years The results indicated that tops of *Phulwa* yielded slightly less than whole tubers under all treatments Sen and Chakravarti (1945) confirmed the earlier results of Pal and Deshmukh (*loc cit*)

Polunin (1943) drew attention to the use of detached sprouts as seed He took sprouts 4½" in length and planted them in boxes He obtained nearly 6 5 lb from 8 plants raised from sprouts

Pushkarnath (1945) conducted detailed experiments on potato sprouts as a source of seed According to him the sprouts, when they are about 1" to 2" in length, are detached from the tuber and planted in a nursery 3 to 4 weeks earlier than the normal time of planting and transplanted in the field when the sproutlings are 4" to 6" in height At Simla the yields obtained from them were reported to be as good as those from whole tubers The use of sprouts as seed is already proving very helpful in rapidly building up the stocks of new potato varieties or hybrids at the Potato and Wheat Breeding Substation, Simla.

Two important questions emerge out of the above observations Firstly, do the plants raised from smaller sets, *i e* tops (chips), eyes, sprouts, etc, yield as well as those raised from the whole tubers? If this is possible then, the second problem refers to the commercial utilization of this method, including method of storage, transport and cultivation If the smaller sets can be

profitably used as seed on a commercial scale, there would be considerable saving in seed and consequently an increase in food Also if suitable methods of their storage and transport are developed, there would be a great economy in storage and transport expenses

Experiments so far done in India have indicated that the chips (tops) and eyes do not yield as well as the whole tubers Although Pushkarnath found the yield from sprouts as good as from whole tubers, experiments done at the Division of Botany, Indian Agricultural Research Institute, New Delhi and at Kanpur (Mitra, 1947 *personal communication*) have not given such good results It must, however, be borne in mind that Pushkarnath conducted his experiments under the conditions of the hills which are quite different from those prevalent in the plains for potato cultivation In this connection Bushnell (1930) observed that there was a gradual decrease in the yield of potatoes as the chips (used as seed) decreased in weight from 15 gm below In his opinion if the chips have to give favourable yields, each of them must weigh at least 1/2 oz and should be 7/8th of an inch in thickness in the centre In the experiments so far conducted in India the chips of much smaller weight have been used as seed Purewal (1947) also obtained similar results with potato peelings and chips He stated that the loss in yield from smaller sets was much more than the saving effected in the quantity of seed planted Work on smaller sets is also being conducted at the Bose Research Institute, Calcutta, but no published record of the work was available to the writer *

Therefore, it has yet to be established whether the chips, eyes and sprouts can yield as well as the whole tuber under Indian condition However, these smaller sets can be profitably used for the rapid multiplication of new varieties the material of which is very limited at the beginning

Much work has been done on the methods of storage and transport of such smaller sets Scannell (1937) has referred to the certified seed "potato eye' trade in Canada He states that this trade started about 25 years ago in the Prairie Provinces He further states, "conditions were quite different then to what they are now Settlers were moving into all parts of Western Canada and many of them were a good many miles from railways By cutting potato eyes and mailing them good seed was made available to settlers in all parts of the country " According to Scannell the eyes are cut from the tubers by 3 methods

(i) An instrument resembling an apple corer the corer is placed over the eye and pushed through the tuber making a cylindrically shaped set with an eye at least at one end The borer is an inch in diameter and the length of the set is governed by the size of the tuber 10 sets weighed 6½ oz , (ii) A potato parer bent into a semi circle this method produces sets of a conical shape and of small size 10 sets weighed 2 oz , (iii) A vegetable baller it is a kitchen utensil The eyes are cut in semi circular form, approximately an inch in diameter and an inch across at the deepest point 10 sets weighed 4 oz The sets are thoroughly coated with slaked lime to prevent drying out and shrinking and can then be kept for several weeks without any apparent deterioration Later, they are boxed or rolled in oiled paper for transport It is estimated that in the spring of 1936 nearly half a million eyes were sold in Western Canada According to the 3rd method of cutting 1 bushel (60 lbs) of Irish Cobbler variety gave about 1000 eyes After the saleable eyes have been removed the remainder of the tuber is used for planting Scannell further reports that very satisfactory yields were obtained by using seed potato eyes

Evans (1943) undertook experiments to develop a method of despatching potato chips by air with reasonable assurance that when planted they would be capable of giving a fair crop Allowing for reasonable delays in packing, despatch and distribution, it was considered that the chips would have to retain viability for about a month According to him the tuber is held in the left hand and a thin chip (1" diameter, ¼" thickness in the centre) cut off the rose end with a sharp knife The chips were collected and placed with cut surface upward on shallow trays, the bottoms of which were covered with a thin layer of peat-moss litter The trays were placed in shelves in a wooden seed store room at ordinary temperature The chips 15 days old gave 80 per cent germination and had shrivelled to nearly half the original size He calculated that 112 lb of such dry chips would be necessary for planting one acre

Marritt (1944) described treating, packing and storing potato eye sets According to him, eye sets are becoming an increasingly important factor in the seed potato trade in Canada because they can be widely distributed at little cost The eyes are scooped out (½ oz in weight, 7/8" in thickness in the middle) with a vegetable baller, they are then washed out in clean water, soon after that they are packed in moisture proof paper A wax coated carton wrapped with waxed craft paper is considered a standard package containing 25 eyes,

*Investigations were conducted at the Bose Research Institute by Dr B K Kar with a view to find out (1) a method for preserving the cut chips of varying sizes 1 cm—2 5 cms over a longer period and prevent them from desiccation, (2) to find the growth and yielding capacity of the chips —severed from the mother tuber at different periods of their preserved life from the havesting time to the sowing time, (3) to find out if the severed sprouts from mother tuber can be practically utilized for propagation

Attempts were made to prevent excessive desiccation by suberizing the cut surfaces or by covering the cut surfaces with a special mixture of shellac wax—India rubber and then storing them in a refrigerator Sealed chips showed less desiccation and sowing experiments also showed better germination and yield dependent, however upon—(1) time of severence from the mother tuber, and (2) period of preservation Germination percentage, growth and ultimate yield increased, with shorter the period of life of the chips separated from the mother tuber with consequent less of desiccation and period of preservation. But the yield from the chips was found to be less than the normal sowing. The severed sprouts were not found practical for propagation (*Loc Cit* —Ed Sci & Cul: and also refer Isolated potato eyes as seeds for propagation by B. K. Kar—*Ind. Jour Hort Soc*, *II*, 41, 1944).

The eye sets are then stored at about 77°F, for 4 days to a week and then at 38°F until shipped. After they reach the destination they are again stored at 35°F till planting.

Nattrass (1945) has summarised the position regarding the healing of the potato pieces. If cut surface is exposed to dry air, it forms a hard crust which readily cracks. There is a considerable shrinkage and loss of moisture. If on the other hand the cut surface is kept in a moist atmosphere, 12-36 hours after the walls of the cells immediately below the cut surface become covered with a deposit of suberin which form a continuous layer blocking the cut surface. This not only prevents loss of moisture but effectively bars the way to rotting organisms such as bacteria and moulds. Within a further period, the duration of which depends on the variety and the temperature, the cells immediately below the blocked surface divide to form a layer of suberized cells which eventually develops into a skin similar in structure and function to the outer skin of the tuber.

The natural healing process can be induced by keeping the cut pieces in a moist atmosphere for 2-4 days after cutting. This can be done by placing the cut pieces in a shallow layer and keeping them covered with moist sacks. The properly healed sets can withstand exposure almost as well as nature whole tubers. Nattrass found that nine months after cutting, the cut pieces were in excellent condition. By this method there is not much loss in weight. Four chips weighing 40 gm underwent only 23% loss in weight after healing while by Evan's method the reduction in weight is nearly 50-60 per cent. But by this new method the chips can be stored for a long period. These pieces have been successfully sent by air from Kenya to England.

At Simla detached sprouts have been found to retain their viability for a week when placed in moisture proof packets.

The position regarding the use of smaller sets of potato, *i e*, chips (tops), eyes and sprouts for seed may be briefly summarized. Experiments so far conducted in India have indicated that the smaller sets generally yield less than whole tubers. One of the reasons for such low yields of the smaller sets may probably be that the sets used by the workers in India have been invariably less than ½ oz in weight, according to Bushnell (*loc cit*) such small sets give correspondingly low yields. This then means that more elaborate experiments are necessary to evaluate the potentiality of the smaller sets. It is quite possible that sets of suitable size, if planted with proper spacing and manures, may give yields which may favourably compare with those from whole tubers. Although the work at Simla has shown that the sprouts can be profitably used for rapid multiplication of improved varieties, more extensive work particularly in the plains, is necessary to evaluate the possibility of its commercial utilization.

Although sufficient work seems to have been done abroad on the problems of storage and transport of smaller sets, it will be necessary to work out these problems for the conditions prevalent in India both in the plains and the hills. Also it will have to be seen how far the disadvantages of low yields of smaller sets and items of additional cultivation like preparing and raising a nursery and transplanting, particularly in the case of sprouts, will balance the advantages of small quantity of seed (which means saving in food, low costs of seed and storage) and low transport expenses.

If, therefore, smaller sets of potato, particularly the chips of suitable size give fair yields, and if suitable methods of their storage and transport for local conditions are worked out, it will help to a great extent towards the expansion of potato acreage in India. And more potatoes means partial fulfilment of an urgent need of the nation, more calories *per capita* per day.

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INSTITUTE OF PALAEOBOTANY

THE foundation stone of the Institute of Palaeobotany, the first of its kind in the world, was laid at Lucknow on April 3 last by Pandit Jawaharlal Nehru Embedded in the foundation stone was fossils from India and abroad, some of them as old as 60 million years Even the handle of the silver trowel used by Pandit Nehru was made of a 16 million years old twig from Patagonia

Palæobotany—the science of fossil plants—has received considerable attention as a result of studies and research undertaken by Profs B Sahni, L Rama Rao, S R Narayan Rao, S D Saksena, V B Shukla and Drs H S Rao, R V Sitholey, G S Puri, A R Rao, K Jacob, C Virkki (Mrs Jacob), and several others in India and the Institute is the only one of its kind in the world The economic value of fossil plants lies in the fact that the spores, pollen and cuticles of higher plants which flourished millions of years back made it possible to subdivide the various formation of the earth into smaller divisions and make their "zoning" possible and thus help the geologist in classification of rocks The palaeobotanist, after a close study of these small remains classify them into small units which he calls 'species' and the analysis of the distribution chart of these species reveal species ranging throughout the entire sequence, species ranging through greater part of it, species with markedly changing frequency and species which are more or less restricted to a certain horizon Using these species as a tool he classifies strata into certain 'biozones' which are so important for correlation of rocks and have successfully been used in oil industry

The idea of placing palæobotanical researches in India on an organised basis started as early as 1929 when Professor B Sahni, the Founder Director of the Institute suggested that it might be possible with aid of the Government fund, to establish a museum of fossil plants in India but it did not gain much support at that time because Palæobotany at that time was still in the budding stage However, in September 1939, a Committee of Palæobotanists working in India which consisted of Professor B Sahni, *Convener*, Dr R V Sitholey, *Secretary* and Drs A R Rao, G S Puri, V B Shukla, H S Rao and K R Mehta as *Members* was formed to co ordinate their activities and issue a periodical report which was edited by the Convener as "Palæobotany in India", six issues of which have already been published On May 19, 1946 eight members of the Committee, who were working at Lucknow signed a memorandum of association and founded the Palæobotanical Society of which Mrs Savitri Sahni was elected the first president The object of the Society was to promote higher studies and researches in palæobotany in its scientific aspect and its application to problems of economic geology In order to further this cause, the Institute of Palæobotany was born on September 10, 1946 with Prof B Sahni as honorary director (see SCIENCE AND CULTURE, December 1948, p. 241)

The aims and object of the Institute is to further the cause of palæobotany by assimilation of knowledge, to carry on original researches in palæobotany and its related branches, to publish a journal and exchange scientific literature, to hold meetings and discussions, to produce popular literature, organise public lectures, excursions, demonstrations and expeditions to promote international contacts, to encourage research through funds, fellowships and scholarship and to train students in various techniques so that they may work in various aspects of palæobotany and solve certain geological problems

In September 1948, the Institute was transferred to an independent building on the University Road Lucknow, which is a gift from the Provincial Government of the United Provinces The proposed building for the Institute is expected to cost about Rs 10 lakhs The Government of India has already given a grant of Rs 1 5 lakhs recurring and Rs 1 5 lakhs non-recurring and more funds, it is hoped, will soon be available Professor Sahni has donated to the Institute all his real property and also his reference library and collection which is a single biggest acquisition so far made *

Addressing the gathering Pandit Nehru, the Prime Minister of India, said

"Science, scientific approach to problems and scientific outlook must be developed if India is to progress in the modern world We may have plans, schemes and so many 'isms', and even we may accept the motive force of science, but what is most essential is to understand the fundamental principles of science I have participated in this function because I believe that now the attention of all in India should be concentrated on science There will be retrogression if we do not develop this mental attitude

"We think in terms of opening new industries by indenting machines from countries like America, England and I think there will be no scarcity of money for this, but the fundamental thing which is needed for an all-round industrial development is technicians"

* A meeting of palaeobotanists working in India was held on January 22 last under the auspices of the Palaeobotanical Society at the Institute of Palaeobotany, Lucknow to discuss the desirability of adopting a generally acceptable system of naming and classifying fossil spores and pollen Prof Sahni, initiating the discussion, placed the various aspects of the problem before the meeting The following speakers discussed the question with reference to their own respective studies of spores and pollen from strata of different geological ages

Professor J Hsü (from the Devonian of China), Dr S Venkatachary, Professor S D Saksena, Professor K R Mehta and Mr. D D Pant (from the Lower Gondwanas), Drs. A R Rao and R V Sitholey (from the Mesozoic), Drs R V Sitholey, G S Puri, V B Shukla and Messrs. B S Trivedi, R. N. Lakhanpal, D C Bhardwaj, and M N Bose (from the Tertiary), Dr G S Puri (from the Pleistocene) The majority of the speakers favoured a system of classification on the lines adopted by Naumova

It was also suggested that a pollen collection be built up at the Institute of Palaeobotany for helping workers in the comparison of fossil material

Pandit Nehru added that the present world was full of complexities and was undergoing a revolution, "not necessarily a bloody conflict" as we were accustomed to understand the term, but our brains are not keeping pace with the rapid developments We hardly realize what is happening in the world today We do not think of the problems of today in their proper perspective What is needed is the systematic understanding of the present day problems

"Politicians think that they are running the whole show in the world The fact is that politicians are so much entangled in various problems that they find very little time to think of fundamental things So those who have devoted their lives to the pursuit of science are really blessed "

Pandit Nehru congratulated Dr Birbal Sahni for establishing an unique scientific research institute in India

Earlier, Dr Sahni, requesting Pandit Nehru to lay the foundation stone, which was specially constructed for the occasion, said that the Institute would forge an international link between various countries of the world Fossils of different ages will be the undying witness of the strange world of the past

More than 100 messages, including those from the U S A, Britain, Russia, China, France, Germany, Scandinavia, Netherland, Switzerland and other countries were received on the occasion Messages were also received from the Governor General, His Excellency Sri Rajagopalachari, the Governors of Bombay and Assam, Maulana Azad, and several eminent scientists and botanists, from India and abroad

OBITUARY: BIRBAL SAHNI (1891-1949)

THE sudden and untimely death on April 10 of Professor Birbal Sahni after a heart attack robs palaeobotanists and geologists of their foremost worker and at an age when his qualities were approaching full fruition

Professor Sahni came of a cultured family of the Punjab and was born at Bhera, West Punjab, on November 14, 1891 He was the third son of the late Professor Ruchi Ram Sahni, a distinguished Professor of Chemistry and a pioneer educationist in the Punjab Professor Ruchi Ram always took keen interest in the advancement of scientific knowledge in this country and through his example Birbal at a very tender age acquired taste for science

Professor Sahni received his education at Lahore and was a student of the Government College, where he studied botany under late Rao Bahadur Lala Shiv Ram Kashyap In 1911 he joined the University of Cambridge, where he became a foundation scholar and later became member of the Emmanuel College Here he came under the inspiring guidance of the late Professor Sir Albert Seward and specialized in Plant Morphology His original researches won for him the degree of Doctor of Science of the University of London in 1920 and later in 1929 he was awarded the Sc D degree of the University of Cambridge

He returned to India in 1919 as professor of botany in the Benares Hindu University and a year later joined the Punjab University in the same capacity Since July 1921 he had been the professor of botany in the University of Lucknow Later in 1943 when the University opened classes in geology, he became a professor of geology as well He organized a first class laboratory and guided research work of Post Graduate students, many of whom took doctorate degrees For several years past Prof Sahni was the Dean of the Faculty of Science of Lucknow University A botanist of great calibre, his early papers ranged over a wide field but later on he was so much inspired by Sir Albert that he concentrated mostly on various palæobotanical problems and was the first to light the torch of this new and fascinating science of fossil plants in our country His work on the *Glossopteris flora*—and the previous idea of a distinct southern

continent the Gondwana Land which consisted of such far scattered countries as India, Australia, South Africa, South America and Antarctica where towards the end of the Carboniferous period an extensive glaciation killed most of the older vegetation and in the wake of this climatic revolution an almost new vegetation appeared while the contemporary northern flora flourished in a tropical climate familiar to us as the Coal Measures of Europe and North America,—is a noteworthy contribution to our knowledge of the Southern Fossil Floras His work threw light on the *Glossopteris* flora and also their relation with the contemporary Palæozoic Angara Land His studies of the Permo-carboniferous floras support the theory of continental drift that India and the southern land blocks were once directly connected together and have since drifted apart 'like the fragments of a disrupted iceberg' His studies on the Mesozoic

floras, particularly the land flora definitely known to be Cretaceous age—which comes from the Himmatnagar sandstone in Western Rajputana and yielded the widespread genera of xerophytic ferns *Matonidium* and *Weichselia*—showed the extension of Wealdon flora in India His studies in collaboration with L R Rao, S R N Rao and K P Rode on the floras of the Intertrapean Series of Deccan have shown that 'the Tertiary era had already dawned when the first lavas of Deccan were poured out' and has dismissed the old version that the Intertrapeans were of upper Cretaceous age This, however, led to another great problem the age of the overlying *Cardita beaumonti beds* which have so far been universally regarded as of Danian age Recently he got interested in the age of the Saline Series of the Punjab Salt Range which on the field evidence appeared to be Cambrian or even pre Cambrian age but have yielded a rich microflora of Tertiary affinities His discovery of a much younger flora in these beds revived the old idea that they may be of Tertiary age and led to two symposia in 1943 at Poona and the other after a re examination of critical sections in the Salt Range by eminent geologists at Udaipur in 1945 in which no decision, however, could be reached since the geologists unanimously agreed that the field evidence was in favour of Cambrian or even pre Cambrian age but could not adequately account for the occurrence of a much younger flora According to Sahni, however, the field observations indicating infra Cambrian position of the Saline Series is due to tectonic movements and that the junction between the Saline Series and the over lying Cambrian is not of sedimentary contact

His more recent work in collaboration with R V Sitholey and G S Puri include the correlation of the Tertiary succession in Assam by means of microfossil types which were confined to them, smaller divisions were also recognized within each major group partly on the absence of certain forms and partly on the relative frequency of those present

From a revision of the Indian fossil Conifers, Prof Sahni concluded that in the Tertiary flora of Northern India and Burma there was no trace whatever of this group of plants Advent of the modern Coniferous flora of the Himalayas dates from the end of Pliocene, when suitable climatic conditions were provided by the elevation of the Himalayas 'The Himalayan Flora—Past and Present' was the subject of a special lecture delivered by Prof Sahni as *Adharchandra Mookerjee Lecturer* of the Calcutta University in 1937 On paleo botanical evidence he put forward a theory, what is regarded as a complement of the drift theory, *viz*, drift ing together of the southern continent and the *Gigantopteris* flora of China, that were separated by the 'Tethys'

Investigations into the Karewa beds of Kashmir have shown that there were three or four glacial epochs during the Pleistocene period and Prof Sahni speculated that perhaps the present civilization was nothing but the phase of an inter-glacial epoch

Prof Sahni was recently invited at a symposium on 'Evolution and classification of gymnosperms'—a group in which he took great interest A twofold division of the gymnosperms into Stachyosperms and Phyllosperms was established by Sahni in 1920 and he indicated the origin of these groups from a common megaphyllous stock In the symposium he established a new group of gymnosperms *viz*, the Pentoxyleæ embracing the characters of both Stachyosperms and Phyllosperms *Pentoxylon Sahnii* has been reconstructed from the parts of the Jurassic flora of the Rajmahal hills, *viz*, *Pentoxylon* (stem), *Nipaniophyllum* (foliage) and *Carnoconites* (female cones) Earlier, he reconstructed the best known of the Bennettitales *viz*, *Williamsonia Sewardiana* from parts of Rajmahal fossils such as *Ptilophyllum* (leaf), *Bucklandia* (stem) and *Williamsonia* (flowers) From the anatomical features of *Homoxylon*, another Rajmahal fossil, Sahni connected the Magnoliales with the Bennettitales through this interesting group, throwing fresh light on the origin of the angiosperm

Professor Sahni was connected with a large number of scientific bodies, Indian and foreign He was one of the founders and an ex president of the Indian Botanical Society and editor of Society's journal for several years He was president of the section of botany in 1921 and 1938, of geology in 1926 and general president of the Indian Science Congress in 1940 He was a Fellow of the Royal Asiatic Society of Bengal, Vice president of the Indian Academy of Sciences and National Institute of Sciences of India and a former President and Foreign Secretary of the National Academy of Sciences of India He was Vice president of the Palæobotany section at the 5th International Botanical Congress, held in Amsterdam in 1935, and was India's delegate to the third centenary celebrations of the Natural History Museum in Paris in the same year

Professor Sahni was elected a Fellow of the Royal Society of London in the year 1936, and was recipient of the *Barclay medal* of the Asiatic Society of Bengal for research in biological science in the same year Towards the end of 1947 he was deputed by the Government of India to tour the research laboratories in Europe, U K and U S A in order to observe there plants, organization and operation Prior to his return to India he attended the 18th International Geological Congress held in London in September 1948 This year a striking tribute was paid to him when he was elected Honorary Chairman of the 7th International Botanical Congress to be held at Stockholm in 1950

His was a life devoted to science, and in 1946 he established the Institute of Palæobotany at Lucknow which is the only one of its kind in the world But unfortunately his untimely death, seven days after the foundation stone of the Institute was laid, has taken away from us a great scholar, a great leader and even greater a friend His love for palæobotany is shown by his last instructions to his wife "Please nourish the Institute" To quote Professor Sir C V Raman, his was a "restless spirit" and the nation has lost in Professor Birbal a great international figure

H. S Puri & A. K. Ghosh

Notes and News

OLD PRINTING PLATES AID COSMIC RAY STUDY

Lead plates used in printing the first issues of the *Physical Review* more than half a century ago are being put to new service by physicists at Cornell University's Laboratory of Nuclear Studies, Director Robert L Wilson revealed today

Dr Wilson said that "we have about 3,000 pounds of old plates which we will use in our laboratory work, mostly in connection with our cosmic ray studies and other high energy radiation work that require the use of lead shielding "

The sole exception is the one mounted in Dr Wilson's office which is from page one of the first issue of the Review for July August, 1893 The plates were turned over to the laboratory recently after having been in storage here since 1913, the last year the Review was published at Cornell (*New York Times*, February 6, 1949)

NEW ABSORPTION DELAYING VEHICLE FOR PENICILLIN

A new repository form of penicillin which gives delayed absorption has been developed recently by F H Buckwalter and H L Dickinson of the Bristol Laboratories, Syracuse, New York

These research workers set up the following criteria for the ideal vehicle repository penicillin it must be non toxic, non irritating and nonallergenic, it must not affect adversely the stability of penicillin, it must possess a viscosity to permit withdrawal into a syringe and administration at room temperature, it should retard the rate of release of penicillin from the site of injection, and it should be of such consistency as to prevent settling of suspended penicillin particles

Gels of the aluminium stearates and vegetable oils meet most of those requirements The viscosity of such a preparation will depend on which aluminium stearate (mono , di , or tri) is used, the type of oil, and the conditions under which the gel is made The high degree of water repellency aids in delaying the absorption of penicillin, and the thixotropic properties of these gels effectively prevent settling of suspended penicillin particles

Various penicillin suspensions containing 300,000 units per c c were administered in doses of 50,000 units per kg to rabbits and the blood level determined periodically for days Procaine penicillin G of small particle size in an aluminium stearate gel could be detected in the blood up to 12 days after an injection In contrast, sodium penicillin G in peanut oil containing beeswax could not be detected in 48 hours (*Inter-American Scientific Publication*, March, 1949)

RADIOACTIVE PHOSPHORUS UPTAKE IN RAT TEETH STUDIED

The rate of uptake of radioactive phosphorus by the teeth after intraperitoneal injection has recently been determined at the Purdue University, School of Pharmacy, Lafayette, Indiana The intraperitoneal injection of 1 c c of a solution cotaining 0 1 gm of radioactive potassium biphosphate with an activity of 200,000 counts per minute per c c , disclosed that the phosphorus is taken up quite rapidly during the first 20 hours, after which the activity of the teeth slowly diminishes

In a second experiment, it was shown that the radioactivity of rats' teeth after injection intraperitoneally of radioactive phosphate, is a linear function of the activity of the phosphate solution injected (*Inter-American Scientific Publication*, March, 1949)

BORON TREATED STEELS

It is reported from the U S National Bureau of Standards that the effectiveness for hardening steel by the addition of small amount of boron depends upon the steel making practice and the amount and form of boron retained in the steels The optimum effect on "hardenability" is obtained when boron is added in the form of simple or complex ferro-alloys, commonly called "intensifiers", "Special addition agents", or "needling agents", to thoroughly deoxidised heats in which the amounts of boron recovered is within the range of about 0 001 to 0 005 per cent It is found that variations from 0-0 006 per cent of boron additions made with either simple or complex intensifiers have no significant influence on the following properties of the steels (1) Cleanliness, except titanium or ziroconium inclusions in some steels treated with complex intensifiers (non-metallic inclusions), (2) hot working (experimental steels), (3) transformation temperatures, (4) resistance to softening by tempering, (5) weldability (experimental steels) and (6) tensile properties of fully hardened and tempered specimens, except possibly an improvement in ductility when tempered at low temperatures Steels with relatively high additions of boron can be rendered fine grained at heat-treating temperatures by the judicious use of grain growth inhibitors such as aluminium, titanium, and zirconium.

The influence of boron on hardenability and on notch toughness of fully hardened and tempered steels varies with the base composition of the steels, the composition of the intensifiers, and the amount of boron present The increase of hardenability due to boron is greater for basic open hearth than for experimental steels prepared in an induction furnace The hardenability of many of the experimental and all the steels comprising basic open-hearth heat is markedly improved by addition of boron In many of the experimental steels the optimum hardenability is obtained with small additions of boron (0 001 per cent or less retained), while in other steels the hardenability increases continuously with increase in boron In other steels, the addition of boron as a simple or complex intensifier is either without effect or impaires the hardenability In general, relatively small additions are more effective than large, and the complex intensifiers are more effective than the simple ones

The effectiveness of boron in enhancing the hardenability increase with the amounts (within limits) of manganese, chromium and molybdenum The hardenability also varies with the state of deoxidation of the heat and the final nitrogen content High soluble nitrogen (and possibly oxygen) is detrimental to the boron effect on hardenability

For the commercial steels, the magnitude of the hardenability effect is independent of the amount of boron added or retained and the composition of the intensifiers The addition of small amounts of boron is often benefical to the notch toughness at room temperature of the steels when fully hardened and tempered at low temperatures (*The Chemical Age*, March 5, 1949)

NEW SYNCHROTRON

At a recent meeting of the American Physical Society at Berkeley Dr Edwin M McMillan, the inventor of the new synchrotron of the University of California at Berkeley, described the principle of operation of the machine The first beam was produced in December and after a few alterations the synchrotron was operated at full energy of 300 m e v in January The impact of the 300-m e v electron beam on a heavy atom produced a beam of 300 m e v x rays which were used for atom smashing bombardments The actual operation of the new synchrotron involved delicate balance between complex operating parts and micro second timing Electrons were accelerated to 300 m e v in "flights", each flight touring the acceleration chamber 480,000 times in 1/120 of a second Each period of operation covered 1/30 of a second, including preparation for the brief period of actual acceleration The machine accelerated six "flights" of electrons each second, remaining out of operation the remainder of the time

Dr McMillan stated that the beam will be used for inducing nuclear reactions and for cold chamber studies of phenomena similar to those found with cosmic rays (*Chemical and Engineering News*, February 28, 1949).

LARGE TELESCOPE CONCERN IN ENGLAND

Cox, Hargreaves and Thomson Ltd , London, is equipping itself to undertake the manufacture of large telescopes This newly formed optical concern of experts is already working on objectives of medium size (up to about 48 inches) One of the partners, Mr John V Thomson, was working in the 200-inch Telescope project in California for two years and has just returned to England, with the experience of constructing large teloscopic reflectors

It is understood that the C H T Ltd will shortly be making a 24 inch Schmidt mirror out of a 5 ply glass disc prepared by the Pickintgton Brothers Ltd at St Helens, Lancashire This disc is prepared by welding thinner glasses together at the softening temperature Although the idea of using ply glass for telescopic disc is not new, the success of this mirror will show, for the first time, its practicability Mr Hargreaves thinks that there is a great future for 'cellular' discs, prepared by similar welding process, for large telescopic reflectors

PALOMAR OBSERVATORY

The 200 inch mirror has been housed in the Palomar Observatory in California towards the end of 1947 After preliminary tests were carried out, it was found that its outer zone, 18 inches wide, is still a little too high, measured in fractions of wave length of light This is suspected to be due to temperature effect, at least partly Measures are being taken to avoid the temperature effect to get the perfect correction in figure If this does not prove satisfactory, the outer zone may have to be polished down in which case the operation will be carried out at the site without removing it to the optical shop in Pasadena

The observatory is starting on a three year programme of mapping the entire available sky with its 48 inch Schmidt telescope which is just complete and installed This is also the largest Schmidt telescope in the world, and will help guiding the programme of the largest 200 inch telescope

RADIO ISOTOPES IN PETROLEUM RESEARCH

Experiments with piston rings made radioactive in the uranium chain-reacting pile at the Oak Ridge National Laboratory forecast benefits to operators of motorized equipment The California Research Corporation, and the isotopes Division of the AEC are successfully using radioactive piston rings to test the effect of fuels and lubricants on engine wear The amount of wear can be measured by an extremely simple and delicate method by which as little as one millionth of an ounce of metal worn from the rings can be detected The Corporation has also developed a method which can indicate just where a given sample of oil is located in a pipe line from outside the pipe As little as one billionth of an ounce of radioactive barium added to the oil before it is pumped into the

pipe can be detected with a Geiger counter The Corporation is using radioactive carbon in an experiment to learn more about the state of gasoline molecules as they pass through the refinery (*Chemical and Engineering News*, February 14, 1949)

INDIA CAN BENEFIT FROM THE U S A PATENT OFFICE

Among constitutional provisions which enhance the individual's worth to himself and to society is the one giving the U S legislature the power to grant him the exclusive enjoyment of his inventions and discoveries for a limited period This is the fountainhead of authority for the U S patent system

By now the patent office has issued a total of two and a half million patents concerning every conceivable human activity in every part of the world These patents constitute the greatest body of technical literature ever amassed Without the various aspects of this patent system, U S A could not have reached anything approaching her present industrial and economic power

The U S A patent system is open to the people of India as it is to anyone in the world except persons who are classed by the U S A as enemy aliens Its protection is given to Indians to exactly the same extent, for exactly the same cost, as it is to American citizens The fees charged by the U S A Government are $ 30 (about Rs 100) upon filing the application, and another $30 upon completion of examination and acceptance If application is rejected, an appeal can be filed for a fee of $15 (Rs 50) The fees expected by the attorney or agent vary considerably The science division of New York's reference library has excellent facilities in this line

Once the patent is issued, there are no additional fees for its maintenance and no provisions for compulsory working or for compulsory licensing under the patent Even if the patentee does not work the patented invention himself, he may prevent others from infringing it There are no renewal fees, taxes, or assesments whatsoever through the 17 years of the patent's existence The total amount paid in ordinary cases is thus $60 (Rs 200) for 17 years' protection In India's patent system, the applicant first pays the Indian Government an application fee of Rs 30 and a sealing fee of Rs 30 After the first four years of the patent (which are free), the patentee must pay renewal fees of Rs 50 for the second four years term, Rs 100 for the third and Rs 150 for the final 4 year term This totals Rs 1,260 for protecting an invention in India for 16 years, as compared to Rs 200 for 17 years of protection in the U S A

The number of patents granted per million population in U S A is 374, while it is only 2 in India 86 8 per cent of the total of patents taken out in U S A annually are taken out by U S A citizens In India, only 10 per cent are granted to Indians and 90 per cent to foreigners In 1946, of the 2,608 applications filed in the Indian Patent Office, 18 per cent were filed by U S A nationals (*World in Brief, News Service*)

INDIAN SCIENTISTS' TOUR OF AUSTRALIA

Keen interest in the scope of scientific investigation in Australia and in the facilities available for modern research, was shown by the members of the Indian Scientists' delegation who have just returned after completing their tour of Australia, in response to an invitation from the Australian Government

The delegation included Dr S Krishna, Director of Forest Products Research, Indian Forest Research Institute at Dehra Dun,

Dr B P Pal, Joint Director of the Indian Agricultural Research Institute, New Delhi,

Lt Col M L Ahuja, Director of the Central Research Institute, Kasauli, and

Mr V P Sondhi, Deputy Director, Geological Survey of India, Calcutta

At Canberra, the national capital, the delegation inspected CSIR laboratories and were received by the Governor General of Australia, the Rt Hon W J Mckell They met also the Prime Minister, the Rt Hon J B Chiefly

Among places visited were the Commonwealth Forestry and Timber Bureau, the Australian Institute of Anatomy and the Commonwealth Observatory at Mount Stromlo

Travelling by air, the delegation then visited the irrigation areas on the Murrumbidgee River at Leeton and Griffith, in the State of New South Wales There they saw farms on which rice and wheat are grown

At Boonoke station, in the Deniliquin district of Riverina, the visitors were able to inspect Australia's most famous Merino stud 'About 70,000 sheep are run on the property At the stud they were shown 25 rams each worth more than Rs 10,660/-

The delegation passed through Echuca, a Murray River township in the State of Victoria which is a centre of dairying and wheat growing At Shepperton, in the Goulburn Valley, they inspected the extensive fruit growing areas which support the biggest fruit canneries in Australia It was pointed out that the Australian wheat research authority, William Farrer, had used Indian varieties of wheat in the course of his breeding experiments, and that some of the Indian strain exists in Australian wheatfields today

Because of the nature of the work carried out at the Forest Research Institute at Dehra Dun, Dr Krishna found his main interest in Melbourne in the activities of CSIR's Forest Products Division Its modern laboratories conduct research into matters relating to timber and the utilisation of forest products generally. Dr Krishna showed keen interest in the work of the various sections, which are devoted to wood structure,

wood chemistry, timber physics, and mechanics, seasoning, preservation, veneer and gluing, and utilisation of timber products

Lt Col Ahuja was particularly interested in the medical research work carried out by the Walter and Eliza Hall Institute, which is world famous for investigations into the problems of pathology and medicine The Institute is directed by Professor F M Burnett, F R S Important activities undertaken at the Institute include large scale production of influenza virus vaccine, study of snakebite and virus diseases of man and animal and the chemical detection of posions

ROYAL ASIATIC SOCIETY OF BENGAL

The 165th Annual Meeting of the Royal Asiatic Society of Bengal was held at Calcutta in the Society's hall at 1, Park Street on February 7, 1949 The Hon'ble Mr Justice Rama Prasad Mookerjee presided

In his presidential address, Mr Justice Mookerjee urged that a conference of Asian Countries should be held early to consider the cultural problems only He said, "This Society is not only to adapt itself to the conditions in an Independent India, but must take due note of the new upsurge throughout the length and breadth of Asia—Asia has now rediscovered its soul India must play a very important part in the growth of Asian uplift During the last few centuries most of the countries in Asia had been dominated politically and economically by different western powers and an idea had been propagated that the people inhabiting the different parts of Asia are as between themselves fundamentally different in their culture and heritage With the gain of freedom in India, Burma, Ceylon and some of the countries in the Far East, it is now possible for the peoples of Asia to think freely and express frankly what their ideals in life had been and should be Representatives of the different Asian countries have been meeting and fortunately two of such conferences were held in India, thanks to the foresight and breadth of vision of our Prime Minister Pandit Jawaharlal Nehru It has been emphasised that the meeting of the Asiatics to have a common platform grow out of a legitimate desire to see the Asian continents to rise to its full stature but it must be remembered that there is no spirit of hostility, much less of threat, to those in other lands who used to domineer, in the past, over whatever was Eastern An opportunity must be afforded to the Asians to plan and execute, orderly and co ordinate, a development along humanistic and international lines" Continuing Justice Mookerjee stressed that this Society was not concerned with the political aspect of the question but rather with the cultural unity of all who are in Asia "The political disputes and differences and the clashes of political ideals, as we are noticing in China, Burma, Malaya, Siam, Indonesia, Syria, Palestine and at other places, will not stand in the way of the Asians meeting on a common platform for more and greater correlation on cultural problems Everybody recognises that wisdom went from the East to the West Can anybody forget that the vedic seers, Zarathustra, Gautama Buddha, Moses, Jesus, Confucius and Mohammed were all Asiatics ? The message of hope, message of truth, message of love all emanated from the East It is still possible for the East to continue to contribute its quota to the solution of the various problems which face the much distracted present day world "

The following awards of the Society's medals and prizes were announced,

Annandale Memorial Medal to Shri Nirmal Kumar Bose for his contribution in Anthropology, Archæology and Ancient Civilization *Durgaprosad Khaitan Memorial Medal* to Dr J C Ghosh for his contribution towards the development of industry in India

The Society's medal for service of peace, unity and progress was awarded for the first time and posthumously to MAHATMA GANDHI

Mr Justice Mookerjee and Dr K N Bagchi were re elected *President* aand *General Secretary* of the Society for the year 1949 50

BOTANICAL SOCIETY OF BENGAL

The Thirteenth Annual General Meeting of the Botanical Society of Bengal was held on March 26, 1949, at the Botanical Laboratory, Calcutta University Dr K Biswas, Superintendent, Royal Botanic Garden, Sibpur, presided and Rai Shri Harendra Nath Chaudhuri, Minister of Education, Government of West Bengal, was the Chief Guest on the occasion

The Education Minister said that no Government could be indifferent to the progress of science in the country Both the Central and Provincial Governments were faced with a thousand and one difficulties after attainment of independence and therefore were not in a position to render sufficient help towards the development of science in the country He was sure that as soon as they would be able to solve the existing difficulties they would pay due attention to this matter

Referring to the prayer of the Society for a grant of Rs 2,500 for publication of its special works for popularising botanical science among students, the Minister assured that Government would see to it that the prayer was granted

Speaking on the subject of 'Botanical Survey of India—Past, Present and the Future', Dr Biswas said that if the country neglected scientific investigation of its natural resources it would have to pay very heavily in the long run The development of the Botanical Survey of India was a vital need for the country, as it will appear from the enormous range and possibilities of botanical exploration of the unexplored and insufficiently botanised regions of India, (including forests of Native States) to the extent of about 125,000 sq miles out of a total forest area of nearly 250,000 sq miles.

India can be conveniently divided into five natural circles, *viz*, (1) North West Circle, (2) Eastern Circle, (3) Central Circle, (4) Southern Circle and (5) Western Circle, and each placed under the charge of a Chief Botanist, who will approximately have about 30,000 sq miles unit area of the country to explore and report upon At the rate of 300 sq miles per botanist per year, no less than 5 to 6 botanists will be required to complete the survey within 15 years At this rate 20 botanists would be required to complete the survey work of the whole area within the specific 15 years

Recurring expenditure under the proposed reorganized botanical survey is estimated to be 2 3 lakhs of rupees in the first stage of development and 4 5 lakhs in the fifth year But unfortunately the entire scheme has now been held in abeyance by the Central Government

Continuing Dr Biswas said, "I confess that I have utterly failed to follow the policy of the Government of India particularly towards the Botanical Survey of India This survey is one of the very oldest Departments of the Government of India Its reorganization scheme was thrashed out and drawn up as long ago as 1919 by the eminent and expert officers who were then Members of the Board of Scientific Advice under the auspices of the then Government of India The reorganization scheme was accepted by the Government of India but the implementation of which was indefinitely postponed on account of the alleged financial reasons prevailing at that time The time I speak of was when so many new Departments what are now characterised as Nation Building Departments now actively functioning were altogether unknown It will thus be quite clear to you that when the financial condition of the Government of India improved the Botanical Survey of India should have received the first recognition and support on the basis of priority claim at least, but intentionally or unintentionally the Botanical Survey of India instead of receiving active and material support was left truncated since the end of 1937" Dr Biswas appealed to the Scientific Public of India to appreciate the actual position of the Botanical Survey of India and ponder over the matter carefully as to whether such a deplorable condition should be allowed to continue any longer

Concluding Dr Biswas referred to the steps he was taking towards coordinating all the different aspects of botanical researches not only in this country, but also in the neighbouring countries of Asia with the Royal Botanic Garden, Sibpur as the centre for disseminating botanical knowledge worthy of India's past tradition in the field of cultural and scientific advancement There was, he said, every possibility and prospect of our organising floristic researches on an All Asia basis and India will take a forward lead to the progress of botanical science in Asia through the revived Botanical Survey of India

Dr K Biswas was re-elected *President* and Shri P. K. Bose was elected *Secretary* for the year 1949 50

ZOOLOGICAL SOCIETY OF BENGAL

The Third Annual General Meeting of the Zoological Society of Bengal was held at the Zoological Laboratory, Calcutta University, on March 27 last Prof H K Mookerjee, Sir Nilratan Sircar Professor of Zoology, Calcutta University, presided

In his presidential address, Prof Mookerjee pleaded for the establishment of National Biological Laboratories parallel to our National Physical and Chemical Laboratories already in existence He said physical and chemical problems when solved render us many advantages but the biological sciences are in no way less important—one is complementary to the other

Continuing, Prof Mookerjee said that in recent years not only a series of National Laboratories were established but also non official institutions, like the Indian Association for the Cultivation of Science, were expanded for the advancement of physical and chemical sciences Unfortunately, biological sciences have been utterly neglected He appealed to the scientists of India to this malfunctioning of science in India, if the country has to progress and to include research in biological sciences at the Indian Association for the Cultivation of Science

Referring to the progress of zoology in India during the past decade, Dr Mookerjee said, our achievements are not negligible although there are ample scope to expand our fields of research He stressed the importance of modern subjects like Genetics and Animal Physiology from the national point of view

Prof H K Mookerjee and Shri G K Chakravarty were re elected *President* and *Secretary* respectively for the year 1949 50

GEOLOGICAL SURVEY OF INDIA

Reserve of manganese ore have been discovered at Tirodi, in the Balaghat District of the Central Provinces, by a party of geologists deputed by the Geological Survey of India, Government of India Investigation was undertaken at the request of the Central Provinces Manganese Ore Company which has been engaged in mining operations in the area for some time past

Parties of the Geological Survey of India working in other parts of the country have reported the discovery of several large deposits of bauxite in western part of Sambalpur, Orissa, small occurrence of magnesite near Ulipuram in the Salem District of Madras, and the occurrence of several seams of coal on the west bank of the Halso river in the Bilaspur District in C P

Brief references to these and other activities of the Geological Survey of India are made in its quarterly report for the period October to December, 1948 The report records that five parties continued investigation for oil in various parts of the country, *viz*, the Jawalamukhi area in East Punjab, Nawanagar State, Cutch, Kathiawar and the frontier tracts of Assam.

Prospecting work continued during this quarter for bauxite deposits in the Belgaum District (Bombay), western part of Sambalpur (Orissa), and Patna District (Bihar) Prospecting for raw materials for glass and ceramic industries continued in the Jubbulpore, Hashangabad and Chhindwara districts of C P Investigation for gypsum also continued in Jodhpur State and Sirmur State (Himachal Pradesh)

The Geological Survey also carried out during this period geological investigations in connection with several river valley projects such as, Bhakra, Kosi, Khoh, Pipri, Hipri, Hirakud and Domodar

The annual Field Training Camp for training geologists was held from November 15, 1948 to January 4, 1949 and 22 newly appointed officers of the Geological Survey of India as well as ten university post graduate students were trained

MILK MARKETING IN INDIA

The problems of marketing of milk and the present undesirable features of milk production, which any plan of improvement of dairy industry in India must guard against, are dealt with in a comprehensive brochure on Milk Marketing in India just published by the Agricultural Marketing Adviser to the Government of India The brochure, copiously illustrated with charts and diagrams, deals with problems of supply, demand, utilisation, price and quality of milk and discusses various aspects of distribution with particular reference to urban supply

The average daily per capita consumption of milk including milk products in India is only about 5 ozs as compared to 41 ozs in the U K and 36 ozs in the U S A Of this meagre ration less than half is consumed as fluid milk as, it is estimated, out of a total production of 45 3 crore maunds of milk not more than 36 per cent is taken as fluid milk In the absence of facilities for speedy assembling, large scale processing and long distance transport of milk, the brochure says, as much as 43 per cent of the production has to be converted into ghee in small villages The bulk of the milk consumed in urban areas is produced at high cost in congested stables of towns and cities under the most unhygienic conditions and adulteration is so widespread that consumers have almost become indifferent to quality

The brochure also indicates the efforts made by the Central and the Provincial Governments during the past five years to arrange supply of milk to urban areas through organization of producers co operatives Co-operative Societies and Unions now handle about 2,200 maunds of milk per day but the part played by them is yet exceedingly small A brief account of Bombay's five-year milk plan estimated to cost over 4½ crores of rupees is also given A number of appendices at the end contain interesting information on cattle statistics in India as well as on the production and consumption of milk

OPPORTUNITIES FOR STUDY ABROAD

The United Nations Educational, Scientific and Cultural Organisation (UNESCO) has published the first volume of 'Study Abroad, International Handbook of Fellowships, Scholarships and Educational Exchange" The book covers over 10,500 opportunities for International Study in 166 subject fields in twenty seven countries In addition, the handbook contains notes on the fellowship programme of the United Nations and its Specialised Agencies as well as summaries of the technique of fellowship administration for those engaged in planning fellowship programmes

The aim of the publication is to increase the number and quality of candidates applying for fellowship, to suggest to prospective donors where new programmes may be developed and to bring into perspective possible overlappings of emphasis and areas of outstanding need The book will be of practical assistance to those wishing to travel out of their own countries, for purposes of study The reporting countries are, Austria, Belgium, Burma Canada, China, Columbia, Czechoslovakia, Ecuador, Eire, Finland, France, India, Italy, New Zealand, Norway, the Philippines, Portugal, South Africa, United Kingdom and United States of America

The book is available with some booksellers in India and can also be obtained from UNESCO headquarters in Paris

SIR BEN LOCKSPEISER

Sir Ben Lockspeiser, Chief Scientist at the Ministry of Supply responsible for conduct of scientific research in all fields of activity of the Ministry excepting atomic energy, has succeeded Sir Edward Appleton as Secretary to the Committee of Privy Council for Scientific and Industrial Research

The appointment of Sir Ben to this important position, opens a new chapter which perhaps may be considered the most important executive post in Government service Sir Ben who is a member of the Scientific Civil Service, has risen from the lowest grade

Previous holders of this appointment are Sir Frank Heath (1916 1927), Sir Henry Tizzard (1927-1929), Sir Frank Smiths (1929 1939), and Sir Edward Appleton (1939 1949)

ANNOUNCEMENTS

DR P MAHESHWARI, Professor of Botany, Delhi University, has been elected a Vice-President of the Morphology Section of the Seventh International Botanical Congress to be held at Stockholm in 1950

AT the Annual convocation of the Forest Research Institute & Colleges, held on March 24, 1949, and presided over by the Hon'ble Pandit Jawaharlal Nehru, Prime Minister of India, Shri K N Tandon, Research Assistant of the Wood Technology Branch, was awarded HOWARD MEDAL—1948 for outstanding research

work on "The Study of the relation between height and diameter growth in some Indian forest trees"

SCHOLARS from overseas who visit Boston and its environs are invited to visit the house of the American Academy of Arts and Sciences at 28 Newbury Street, Boston 16, Massachusetts The staff of the Academy will be happy to co operate in arranging travel and hotel accommodations and personal contacts with scholars and institutions in the Boston district

BOOK REVIEWS

The Ways of Fishes—By Leonard P Schultz and Edith M Stern Pp i-xii, 1 264, 80 text figures, 1948 Macmillan & Company, Limited, St Martin's Street, London Dollar price $4 00, Sterling price 22s net

The Ways of Fishes comprises of four main sections, each catering to different tastes The first 13 chapters upto page 181 illustrate some selected aspects of the ways of fishes, Chapter 14 (pp 182 193) deals with fish management and some aspects of fisheries research, Chapters 15 and 16 (pp 194 218) give ABC's of Home Aquaria and an account of fishes suitable for such aquaria and the Appendix (pp 219 247) contains a classification of Fishes This is followed by a General Index (pp 249 258) and an Index of Scientific Names (pp 259 264) The figures are simple but very much illustrative of the points intended to be portrayed or emphasized

In the first section of the book, there is an immense wealth of information on certain aspects of fish life which is bound to interest a general reader, especially as it is given in simple non technical terms This information is based mostly on personal observations or taken from the writings of present day workers For a general reader, it may be an advantage that the book is not burdened with references, but a scientific reader is likely to miss them The variety of topics dealt with is clear from the titles of various chapters Migration, Locomotion, Hibernation and Aestivation, Fishes Dangerous to Man, Feeding Habits, Association with other Animals, Males that Incubate, Electricity and Luminescence, Sound and Sight, Ocean Beach Spawners, Giants and Dwarfs and Nest Builders in Streams The most pleasant feature of the work is that each chapter leads to the next imperceptibly so that a general continuity of story is maintained throughout

In the Chapter entitled "Fishes Controllable by Man", the authors point out the similarities between the principles of management of domestic animals and fishes, particularly those cultured in ponds A simple and brief account is given of the Methods of Fish Management in Streams, Lakes and Sea and a special reference is made to the control of the north-Pacific Deep Sea Halibut through scientific investigations and administrative measures

The two chapters dealing with Home Aquaria are sufficiently informative for a beginner in aquarium hobby Attention is invited to the oxygen, light and temperature requirements of fishes and the role of the plants, changing of water, food and other animals in a balanced aquarium is indicated Various hazards that may afflict aquarium inhabitants are mentioned The technique of setting up a balanced aquarium is explained Criteria for selecting fishes for the aquaria are given and fishes suitable for aquaria are listed in their evolutionary order

The Classification of Fishes given in this book cannot be of any use to the general readers of the book, but it is a boon for fish taxonomists as a general reference work According to Schultz and Stern, fishes are grouped into 9 classes, 66 orders and 570 families, whereas according to Berg there are 12 classes, 114 orders and 604 families Jordan had enumerated 6 classes, 71 orders and 638 families Schultz and Stern have rightly observed that "Such disagreement is a healthy condition in the field of ichthyology, because it indicates that new facts are being discovered and these change the conceptions of relationships, thus altering the arrangement of the orders and families of fishes Our knowledge is too imperfect to arrange the groups in a truly natural classification" Points of special significance for Indian ichthyologists are the following

1 Family *Chaudhuriidæ* Annandale is removed from the *Mastacembeloidæ* (=Opisthomi) and, following Berg, has been raised to the rank of an Order Chaudhurioidæ The two are, however, placed together showing close relationship

2 The Family *Horaichthyidæ* Kulkarni is placed in the Suborder Poecilioidæ (Order Cyprinodontidæ) next to Anablepidæ and Tomeuridæ rather than to the

Cyprinodontidæ to which it is undoubtedly closely allied

3 The retention of the Family *Adiposidæ* Jordan for *Adiposia* Annandale & Hora is perhaps not justified, *Adiposia* belongs to the *Cobitidæ*

It is further a matter of gratification to record that the taxonomic changes of the family rank proposed by Indian ichthyologists during the last quarter of a century have been accepted in this work

The reviewer feels that the authors could amplify the classification of fishes and publish it separately rather than include it in a charming, general work dealing with the ways of fishes

S L H

Animals Alive—By Austin H Clark D Van Nostrand Company, Inc, New York, 1948 Pp vii + 472 Price $4 00

The author, Dr Clark, is a well known biologist attached to the United States National Museum, Washington, D C In the course of his long service at this Museum, he has also had exceptional opportunities of studying animal life in its natural surroundings in various parts of the world As a result, he is exceptionally well-qualified for producing an authoritative and well written account of the living animals or as he designates them the 'Animals Alive' The main object of the work is to indicate, as succinctly as possible, the relations of man to the animal world and the relations of various types of animals to each other, to the plants and to the physical environments, whether on land, in fresh waters or in the seas Finally, he has tried to assess the relationships of the living world to the universe as a whole This big task the author has attempted to carry out in 38 Chapters arranged in four Sections the first deals with Man and the Animal World, the second with Land Animals, the third Freshwater Animals, and the fourth Animals constituting the Sea Life In reviewing the whole of animal world including all the diverse classes of animals, such as worms, molluscs, insects, fish, reptiles, birds and mammals, the author has produced a work on Natural History of a very high order

As he has described in this book, animals are found at almost the highest altitudes, above the mountain peaks, and in the ocean depths up to roughly 4 miles living on the dead sea animals and plants in varying conditions of life As such, they exhibit a very high degree of adaptation to the type of *milieu* which each class frequents and to which it is beautifully adapted The extraordinary sizes of some of the animals, such as, the 80ft tropical sea worms, the huge whales, squids and land animals like the elephant etc, are described in their proper context and with these are also considered the minute water animals which are found swarming in fresh and saline waters The peculiar life histories of different classes of insects and other animals and the great changes undergone by them during their development and the intricate adaptations of animal life to the extraordinary balance of nature established in the various types of *milieus* are discussed in a very readable form In short, the work provides one of the most interesting and authoritative monographs on a subject which should interest not only the zoologists but also the lay man The only criticism one would offer is that it is a highly concentrated *melange* and, as such, is not often easy to digest The book is copiously illustrated, but the figures, though accurate, cannot be regarded as highly artistic The book is exceptionally well produced and considering its size and the material, the price of 4 00 dollars is not excessive

B P

Water Transport Origins and Early Evolution—By James Hornell pp XV+307, Plates I to XLV and a Map showing Distribution of Types Cambridge University Press, 1946

Mr Hornell in this work sums up his own researches on boats, dugouts and rafts in different parts of the world, and also fully utilises the labour of other scholars in this field As Director of Fisheries in India and Ceylon, during the greater part of his life, and a specialist in this field who worked in numerous areas in Oceania, Indonesia, Africa, and Asia Minor, Mr Hornell had unrivalled opportunities of observing water craft of various types The numerous monographs and papers contributed by him in different journals and publications have placed before the anthropologist his earlier observations In this latest publication, Mr Hornell has discussed the entire data available, and tried to formulate theories of origin and different types of water crafts

In the first part of the work the author describes different types of floats and rafts, in the second part he describes skinboats and in the third and last part bark canoes, dugouts and plank built boats With regard to the types of rafts and floats described in part A it is permissible to point out that the gourd raft occurs in India and has been described (Chattopadhyay, K P, Two Indian Rafts, *J R A S B* Vol X, 1944) Also *shola bhela* of a somewhat more elaborate kind than that mentioned by Hornell occurs in North Bengal and is used for fishing on the wide marshes of that area (Chattopadhyay, *ibid*)

The sections on origin are not so rich in detail as the descriptive portions The study of elaborate skin boats—the curragh, the umiak and kayak—starting from the simplest types, is masterly The derivation of the umiak and kayak from the coracle is however distinctly inadequate in detail The section entitled "The generic relation of the bark canoe to dugouts and plank built boats" is much more convincing The plates illustrating different types of watercraft are excellent There is also a voluminous bibliography and a good index.

K. P. C.

Aircraft Structural Analysis—Edited By G N Mangurian and Norman M Johnston Prentice Hall Inc , 70, Fifth Avenue, New York 11, N Y , U S A Cloth, 6″×9″, pp viii+418, 1948 Price $ 8 00

The developments in the production of aircraft structures, from the pioneering period of Wright brothers some five decades ago upto the present, have necessitated a deeper and fuller understanding of the principles of the theory of structures and their applications in aircraft design The outcome of this can be seen in the number of texts and reports now published on this subject The present volume is one among many such publications, and aims to give an engineering draftsman a grounding in the principles of designing aircraft components, and to familiarise him with the elementary principles of stress analysis

The special merit of this work lies in the fact that it has been prepared by the staff of Glen L Martin Company,—America's foremost aeronautical concern —and therefore contains, as should be expected, a wealth of practical information on structural design, usually not found in ordinary texts on the subject As the emphasis is more on the practical than on the theoretical side, a slight looseness in technical terminology is observed at places The methods and procedures are described through actual examples of problems encountered in aircraft engineering Beginning with the loads on a basic structure, the analysis on a detailed structure are given, followed by selection of material, design of section, determination of stresses and their comparison with allowable stress

There are six chapters dealing with the subject of structural fastenings with rivets and bolts but nowhere among them is any mention made of the technique of welding in any form On page 336, while discussing the question of weight saving a casual mention is made of welding and brazing, but no attempt is made anywhere to describe its underlying principles The growth and development of monocoque and semimonocoque structures, as well as high performance low drag airfoils have enormously increased the value and applications of welding in aircraft and the reviewer was therefore surprised to find a conspicuous absence of this subject from the text A chapter or two on the general principle of this fabricating technique would certainly have added to the completeness of this work Among the various tables given in the Appendix, Table 49 on page 393 giving the "Materials Properties— Sheet Stock", is the most interesting and one which the reviewer believes is published for the first time in such a comprehensive manner in a text After giving the values of the mechanical properties a comparison of wood, plastics, aluminium, magnesium and steel alloys is made as regards their relative weight for equal strength and relative weight for equal stiffness, with aluminium alloy 24ST as a standard As many as seventeen different alloys and forms of these materials are compared and their uses in the various components of an aircraft are specified A very lucid picture is thus afforded from this table of aircraft structural materials

Good illustrations, simple and straightforward approach and systematic methods of presentation render this text useful to aeronautical draftsmen and undergraduate engineers

S K G

LETTERS TO THE EDITOR

[*The Editors are not responsible for the views expressed in the letters*]

MULTI HEADED SORGHUM

The attention of the writer was drawn to a *Jowar* plant *Sorghum vulgare* Pers , which bore seven panicles in 1945 season Since the seeds had already formed, no attempt was made to self it The plant grew singly far away from *Sorghum* crops and very likely was self pollinated Only a few seeds could be obtained from this plant, which is considered as F_1

In 1946 season, the seeds were allowed to germinate in April, when the first shower came Only one plant survived During stormy weather, it had fallen , but the growth continued along the ground to a considerably long distance This plant bore 5 panicles as shown in the inset of the photograph

Before the flowers opened, the panicles were bagged individually and seeds were collected separately from each panicle This plant was designated as F_2, having the following characters

Culm stout, 5½ meter high, total number of nodes 53, average circumference at the nodes 12 cms , at internodes 8, cms , internodes 10 cms , and adventitious roots continue to the 35th node Leaf blades up to 1 meter long and 9 cms wide with no chlorophyll deficiency Sap colour whitish, stalks pithy and full, panicles loose, elliptic oblong, spikelets with green pedicels Length of panicles from 18 25 cms and breadth 10 18 cms Peduncles erect, rachis elongate, striate and shallowly channelled Branches many at nodes, spreading, flexuous, base stout and hairy Racemes 3 to 5 noded Sessile spikelets elliptic to elliptic oblong, acute apex, 5 6 mm long and 2 2 5 mm wide when in flower and 3 3 8 mm wide when in fruit Coarsely hairy throughout, except the tip The pedicelled spikelets linear, subulate, neuter, often reduced and persistent.

Seeds were collected from every panicle separately and stored for the next season They were sown in separate plots in the first we^k of April 1947 The

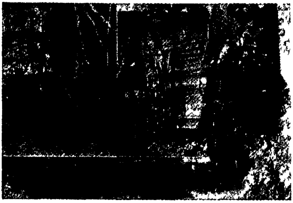

Photo of Jowar Plant

seeds germinated on the 5th day No marked difference was noticed in the plants grown from the seeds of separate panicles These plants were designated as F_3 Occasional irrigation and early showers helped their further growth In general, the plant resembled parent F_2

Flowering and fruiting started from November Many plants bore 3 to 4 panicles, some bore 5 to 6 panicles, while a few continued to bear panicles throughout the year, up to a total of 14 panicles from the main plant and 3 to 4 panicles from its tillers, as shown in the inset of the photograph The panicles which appeared later in the season became smaller and smaller on the main plant, but their size was fairly satisfactory in the tillers The quality of the grains remained the same throughout The characters of this plant F_3, have been shown on the same model as given by Ayyangar[1] for his specimen in order to provide general comparison of various parts (Fig 1)

Another set of sowing from the seeds of F_2 was made later in the season, on the 10th October, 1947, more or less at the close of the rainy season in Bihar The seeds germinated on the 5th day, but the plants attained an average height of 1 to 2 meters only On an average, the plants from the later sowings, had poor vegetative as well as reproductive development These were designated as FL_3 At first they produced only one panicle, but later 3 to 4 panicles developed from the main plants In addition, they produced tillers from 4 to 8 in each plant and these tillers in their turn produced 3 to 4 panicles and additional tillers The quality of seeds remains the same as before

F_3 also produced tillers in large numbers, from 5 to 10. These tillers showed marked resemblance with FL_3 in respect of vegetative and reproductive growth Some seeds of F_2 were also supplied to Dr R H Richharia, Economic Botanist to the Govt of Bihar, Sabour There, the seeds were planted late in the season and the results thus obtained were similar to the corresponding late sown crop at Patna, FL_3

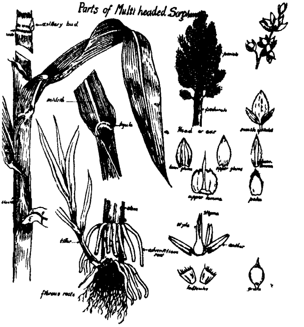

Fig 1

For convenience, the tillers from the early sown plants were designated as FT_3 and from that of the late sown crop as FLT_3 At the time of writing, F_3, FL_3, FT_3 and FLT_3 are still green and growing in the experimental plots and exhibit a tendency to become perennial They are shooting out new leaves, new panicles and new tillers even after 13 months Thus it has been possible to get flowers and fruits on *Jowar* throughout the year

F_4 seeds have also germinated and it is also interesting to note that each individual seed produces 3 to 5 plants from the very beginning and all of them show equal vigour The work is still in progress

R C LACY

The Botanical Laboratory,
Science College,
Patna 20-4 1948

[1] Ayyangar, G N R, and others—The description of crop plant characters and their ranges of variation, IV Variability of Indian *Sorghum* (Jowar) *Ind Jour Agr Sc.*, 12, 528 563, 1942

THE INFLUENCE OF VARIETY ON THE PROTEIN CONTENT OF GROUNDNUT (*ARACHIS HYPOGEA*)

Varietal differences in protein content of cereals and pulses were observed by several workers[1] Among groundnuts there are large number of varieties and the information on their protein content as affected by variety is quite meagre The present investigation was taken up with a view to determining variations that might exist in the protein content of a number of breeding stocks and trial varieties of groundnut The varieties used in this experiment were grown under identical conditions at Hebbal Agricultural Farm, Government of Mysore

The protein values are calculated from the content of the defatted material estimated according to the method of Chibnall *et al*[2] and the results are summarized in Table I

TABLE 1

Description of the material		Protein content
I *Spreading, commercial varieties*		
1) Mauritius (G 0115)		53 5
2) Mysore local (G 0120)		49 2
3) Virginia (G 0284)		51 0
4) Big Japan (G 0020)		52 2
5) Carolina (G 0088)		47 3
6) Pondicherry (G 0126)		50 9
II *Spreading, improved varieties*		
7) D_2 (G 0788)		46 3
8) T_{13} (G 0997)		52 4
9) West African (G 0768)		53 1
10) Bassi selection G(0771)		48 8
11) Pondicherry No 8 (G 0787)		52 4
12) Bassi (G 0019)		59 9
13) Phillippine white (G 0125)		48 4
14) *A Nambyquearæ* (G 0123)		51 0
III *Early, erect varieties*		
15) Valentia (G 0261)		57 1
16) Tennessee White (G 0226)		54 4
17) Small Japan (G 0131)		56 1
18) Coreantes (G 0105)		56 0
19) African white (G 0003)		52 6
IV *Erect late varieties*		
20) African red (G 0001)		48 1
21) A K 8 11 (G 0784)		50 1
22) Bunch virginia (G 0291)		52 8
23) H G_1 (G 0106)		53 2
24) Castle cary (G 0970)		47 7
25) Samaru (G 0973)		44 6
26) Sataragrey (G 0791)		45 3
V *Hybrids*		
27) Hybrid	(G 0553)	50 9
28) ,,	(G 0480)	49 7
29) ,,	(G 0385)	48 5
30) ,,	(G 0341)	58 8
31) ,	(G 0549)	52 1
32) ,,	(G 0184)	47 4
33) ,,	(G 0779)	48 1
34) ,,	(G 0717)	56 3
35) ,,	(G 0173)	54 8
36) ,,	(G 0343)	49 3

From the results in the above table it is clear that there is quite significant difference in the protein values of various varieties of groundnuts—the range being 44 6—59 8 gms. of protein per100 gms. of defatted flour. Since the conditons under which they were grown are identical, the main contributing factor for their difference is variety

Our thanks are due to Prof V Subrahmanyan and Dr K V Giri for their keen interest in the above work and also to Dr L S Daraswamy, Economic Botanist, Department of Agriculture, Government of Mysore and his assistants for supplying the material used in the above investigations

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AN INTERESTING CASE OF BOTANICAL NOMENCLATURE

When a plant has a number of synonyms the correct or the legitimate name is generally ascertained on the basis of the earliest published valid name This method is sometimes complicated when two such names referring to the same plant are published on the same day In the present note, we shall briefly refer to two such instances already recorded by Chatterjee,[1,2] and add a third one for the first time

It was pointed out that by a curious coincidence both David Don and Robert Brown independently described a plant on the same day under the names *Jacaranda mimosifolia* D Don and *Jacaranda ovalifolia* R Br Both these names were validly published with proper descriptions and plates, and as they both refer to the same plant, they are to be regarded as synonyms As rules of priority cannot be applied, the correct name is determined by the name adopted by a subsequent author and thus *Jacaranda mimosifolia* D Don was accepted In this case, either of the two names was validly published and the names in the text agreed with the names in the plates Very rarely however, the corresponding names in the text and in the plates do not agree, and according to the rules, plates published prior to 1908 may validate a species if they are accompanied by a name and analyses of essential characters When Royle[3] published a description of *Incarvillea arguta* Royle, he gave a coloured plate to illustrate his plant In the corresponding coloured plate, the given name is not *Incarvillea arguta* Royle as is expected, but *Incarvillea diffusa* Royle Both these names are therefore validly published by the same author in the same work Fortunately, we now know, that Royle's work was issued in fascicles and the plate

containing the name *Incarvillea diffusa* Royle was published and distributed some five months earlier than the corresponding text Therefore, under the rule of priority, the earlier name available on the *plate*, *i e*, *Incarvillea diffusa* Royle, has been regarded as the correct name

We have now discovered another instance which some what combines the case of *Jacaranda and Incarvillea* This refers to two names *Plagiopteron suaveolens* Griffith (the name in the text), and *Plagiopteron fragrans* Griffith (the name in the plate) Both these names denote only one plant and were validly published at the same time[4] The plant belongs to *Plagiopteron* —a genus of uncertain position in the order *Malvales* When Griffith described the genus, he suggested that it might belong to *Malpighiaceæ* or *Sapindaceæ* Later Masters[5], Kurz[6,7] and Warburg[8] put it in *Tiliaceæ*, *Malpighiaceæ* and *Flacourtiaceæ* respectively Subsequent authors mostly followed Masters Recently Gilg[9] has put *Plagiopteron* at the end of *Flacourtiaceae* under genera of uncertain position and suggested that it belongs at least to *Malvales* Gilg says, '*plagiopteron* Griffith ist sehr wenig bekannt Nach der Beschreibung mochte ich die Gattung zu den *Malvales* stellen "

The plant is described under the name *Plagiopteron suaveolens* Griffith, and figured in the next page with analyses of floral parts under the name *Plagiopteron fragrans* Griffith So, technically both these names were validly published on the same day The correct name will therefore be ascertained by the name adopted by the first subsequent author This happens to be Masters as shown below

PLAGIOPTERON FRAGRANS *Griffith*—Masters in Hook f Fl Br Ind 1 399 (January, 1874)

Plagiopteron suaveolens Griffith— Kurz in Journ As Soc Bengal 43 pt 2, 138 (October, 1874)

It will be noticed that although Kurz adopted the name *Plagiopteron suaveolens* Griffith in the same year as Masters, he was at least eight months behind Masters in his publication of the name Subsequent authors like Gamble[10], Warburg[8], Brandis[11], Kanjilal and Das[12] have followed either Masters or Kurz as they liked

An examination of the type sheet at the Kew Herbarium shows that the name *Plagiopteron fragrans* Griffith is written in Griffiith's own hand (the writing exactly agrees with a number of Griffith's original letters to Sir William Hooker which are preserved in the library of the Kew Herbarium) The same name (*i e*, *Plagiopteron fragrans* Griffith) occurs in the plate no 13 and again as a heading to the explanation of the place (*i e* 246) All these support the view that Griffith actually intended to call his plant *Plagiopteron fragrans* In our opinion, the other name, which occurs only once in the text (*l c* 244) may have been used by Griffith unintentionally. We find from the text that he compares the odour of his *Plagiopteron* with another plant *Roydsia suaveolens* It may be quite possible that at the time of writing the text he was influenced by the specific epithet of this other name and used it by an error—the two epithets *suaveolens* and *fragrans* conveying the same meaning Griffith's type sheet in the Kew Herbarium does not bear any field number The number cited by Kurz[6] (*i e*, 679) evidently refers to the *Kew Distribution number* which was given when Griffith's specimen was later distributed from Kew

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8,9 Engl Pflanzenfam, *3 6a*, 55, 1894, *21*, 456, 1925
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5,6—BENZOQUINALDINIC ACID AS AN ANALYTICAL REAGENT

This reagent was prepared by the oxidation of 5,6—benzoquinaldine according to the method of Hammick[1] with a little modification, the base of m p 54 C (picrate of the base melts at 222°C with decomposition) was prepared by modifying the method of Doebner and Miller[2] This reagent of m p 187°C, is soluble in alcohol, acetic acid, less soluble in hot water, and sparingly soluble in cold water It was found that practically all the bivalent metals are precipitated by the reagent Copper gives a light green crystalline precipitate With Cd, Co, Ni, Mg, Ca, Sr, Ba, Zn, Mn, Ag, Hg, Pb, etc, white precipitates are obtained Copper salt is sparingly soluble in dilute mineral or acetic acid, but dissolves in strong acids, in large excess of ammonia and also in cyanide solution All other salts are more or less soluble in dilute acids Ba, Ca, and Sr,—salts are soluble in hot water Zn, Mn, Ag, Cd, Co, and Ni—salts are soluble in cyanide solution Ammonium acetate dissolves the mercuric and lead salt of the reagent The Copper salt dried at 110°—120°C is of composition ($C_{14}H_8NO_2$), Cu, $1\frac{1}{2}H_2O$. With ferrous salt the reagent gives a red coloured compound which dissolves in a solution of cyanide The intensity of the coloured system thus produced varies with the concentration of the ferrous ion

Details of the work regarding the preparation

and use of the reagent for the estimation and separation of metals will be published elsewhere

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NO RAIN FALL WEEKS AT PATIALA

Mahajan had previously studied the Rain-fall Frequency at Patiala[1], Rain fall in Patiala State[2], and Rain fall at Patiala[3] The weekly rain-fall at Patiala of the last fifty years has since been studied

The daily rain fall data of Patiala for the years 1900 1948 were collected from various sources *e g*, the Meteorological Observatory, the Irrigation and Revenue Offices etc The weekly rain fall of all months of all the years was calculated as follows

In order to simplify matters, each month is divided into four quarters (weeks)

First Quarter —
(i) 1st day to 7th day of a month =7days
Second Quarter —
(ii) 8th day to 15th day of a month =8 days } ½ month
Third Quarter —
(iii) 16th day to 22nd day of a month=7 days
Fourth Quarter —
(iv) 23rd day to 28th, 29th, 30th or 31st of a month =6-9 days } ½ month

The number of quarters (weeks) having no-rainfall associated with them, during the period from 1900 1948 A D were calculated and are given below in Table I which also indicates the percentage of probability of no rain fall in a quarter (week) and a month

The table shows that the first quarter (week) of November has the maximum probability of no-rainfall (94%) The third week of November and first week of December have also equally very high probability of no rain fall (92%) The second and the fourth weeks of November have 86% probability The third and the fourth weeks of April have also high probability (82% and 84% respectively)

The minimum probability of no rain fall(4%) occurs in the last week of July and next to it, in the first week of August (8%) The other weeks of July and August have also low probability

Thus the minimum probability of no rain fall is from 23rd July to 7th August and maximum probability from 1st November to 7th December

TABLE 1

Period 1900 —— 1948 A D = 49 years

Serial No	Months	1st—7th day: No of weeks of no rain fall	1st—7th day: % probability of no rain fall	8th—15th day: No of weeks of no rain fall	8th—15th day: % probability of no rain fall	16th—22nd day: No of weeks of no rain fall	16th—22nd day: % probability of no rain fall	23rd—end of the month: No of weeks of no rain fall	23rd—end of the month: % probability of no rain fall	Monthly Total: No of weeks of no rain fall	Monthly Total: % probability of no rain fall	Remarks
1	2	3	4	5	6	7	8	9	10	11	12	13
1	January	31	63 3%	24	49 0%	25	51 0%	26	53 0%	106	54 1%	Total number of years '49
2	February	24	49 0%	27	55 1%	26	53 0%	31	63 3%	108	55 1%	
3	March	25	51 0%	27	55 1%	33	67 5%	30	61 2%	115	58 7%	
4	April	34	69 4%	37	75 5%	40	81 6%	41	83 7%	152	77 6%	Total number of quarters =196
5	May	38	77 6%	32	65 3%	30	61 2%	34	69 4%	134	68 4%	
6	June	25	51 0%	25	51 0%	21	42 9%	13	26 3%	84	42 9%	
7	July	11	22 5%	7	14 3%	7	14 3%	2	4 1%	27	13 8%	
8	August	4	8 2%	9	18 4%	7	14 3%	6	12 3%	26	13 3%	
9	September	13	26 5%	13	26 5%	25	51 0%	26	53 0%	77	39 3%	
10	October	38	77 6%	40	81 6%	38	77 6%	39	79 5%	155	79 1%	
11	November	46	93 9%	42	85 8%	45	91 8%	42	85 8%	175	89 0%	
12	December	45	91 8%	37	75 5%	32	65 3%	33	67 3%	147	75 0%	

The monthly probability of no rainfall is given in the column 12 of Table I The month of November has maximum probability of no rain fall(90%) The months of October, April and December have also high probability, the values being 79%, 78% and 75% respectively

The minimum monthly probability occurs in August (13%) The month of July has also equally low probability (14%)

Thus the monthly probability also confirms that

the month of November has maximum probability of no-rain fall and July and August the minimum probability

The authors are grateful to the Governments of Patiala and East Punjab States Union, Patiala, for providing facilities to conduct scientific research

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ELECTRON MICROGRAPHS OF CERTAIN TEST SPECIMENS

A description of the new electron microscope installed at the Institute of Nuclear Physics, Calcutta has been published recently[1] In the present communication a few micrographs obtained with the new instrument are presented These micrographs were taken with an energy of 50 ekv, at the preliminary stages of adjustment of the instrument Many metallic and non metallic smokes were examined as test objects, a few familiar types of bacteria being also investigated Fine particles present in the oxide smokes of certain metals like magnesium and zinc show well defined characteristic shapes when examined under the electron microscope In general, they have a wide range of size distribution and are quite stable under intense electron bombardment, so that they serve as good test objects for checking the operation and performance of the microscope

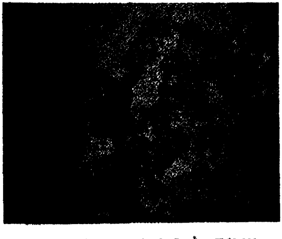

Fig 1 Magnesium Oxide Smoke X 21,000

The four plates reproduced here are the early electron micrographs of three oxide smokes and a bacterium. Fig 1 shows magnesium oxide The specimen was prepared by burning magnesium metal in air and collecting the oxide smoke on bare wire-screen having 200 meshes per inch The oxide particles tend to form chains reaching out from the edges of the meshwire towards the centre of the mesh openings and do not require any supporting film The micrograph indicates the oxide particles to be perfectly regular and cubical This can be correlated with the fact that magnesium oxide is an ionic crystal having a simple cubic space lattice

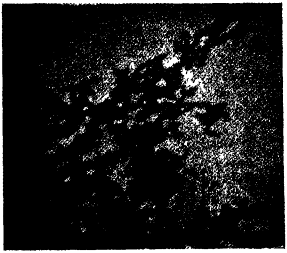

Fig 2 Carbon Particles X 10,000

Fig 2 shows carbon particles, the specimen being made by burning benzene in air and collecting the soot on a bare wire mesh The structure of the individual particle is not revealed clearly in the micrograph, but the chain formation is fairly apparent

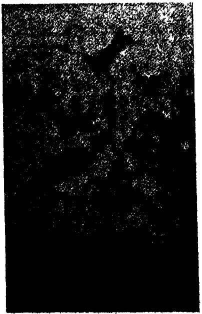

Fig. 3. Zinc Oxide Smoke. X 14,500

Fig 3 is the electron micrograph of zinc oxide, the object being prepared by burning pure zinc in an oxy-coalgas flame and collecting the smoke as above The skeletal tetrahedral appearance of ZnO particles can be observed It is known that crystals of ZnO are dihexagonal polar, and explanation for this difference as suggested by Barnes and Burton[2] is that these are skeletal crystals which would assume hexagonal forms on continued growth, the preferred direction of growth being the Zinc oxygen tetrahedral configuration of the space lattice

Fig 4 Bacillary and Filamentous form of *E Coli* X 10,000

Fig 4 is an electron micrograph of the bacillus *E Coli* A droplet of the bacterial emulsion in distilled water was placed on a wire mesh covered with a thin collodion film and examined as such in the microscope after desiccation The rod like shapes are clearly evident

The individual magnifications are indicated under each micrograph

Thanks are due to Prof M N Saha and Dr N N Dasgupta for the laboratory facilities

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STUDIES IN THE CATALYTIC PRODUCTION OF BUTADIENE FROM ETHANOL II

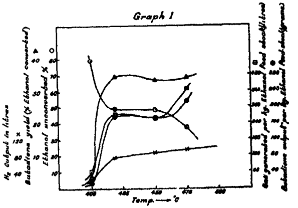
During the course of our investigation on the production of Butadiene from Ethanol, a Catalyst with Magnesium oxide Silica Aluminium oxide in the proportions 75 15 19 8 5 058 respectively was developed and studied (Catalyst II)[1]

The effect of temperature on the yield of various products was studied, and the following data were computed

TABLE 1

Temp	Gas generated per kg EtOH feed stock litres	Butadiene yield on EtOH converted %	Butadiene output in gms per kg EtOH feed stock	Hydrogen produced (in litres)	EtOH Unconverted %
400°C	63 22	7 12	14 63	23 10	79 45
420°C	269 00	34 40	176 80	76 54	48 57
450°C	259 70	33 44	173 90	88 88	48 00
475°C	371 90	34 34	215 80	95 52	37 14

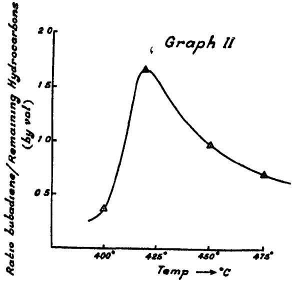
It will be observed from graph I that though the amount of ethanol decomposed and the amount of



the gas generated increase with temperature, the yield of butadiene (on ethanol converted) is maximum at 420°C This therefore is the optimum temperature for this catalyst The amount of by-products, e g, unsaturated hydrocarbons etc. produced at 475°C is much higher than at 420°C as can be noticed from graph II wherein the ratio of total butadiene produced to the remaining unsaturated hydrocarbons in the gas mixture has been plotted against temperature.

TABLE II

Temperature	"A" Butadiene produced litres	"B" By products (other unsaturated hydrocarbons) litres	Ratio A/B
400°C	0 240	0 649	0 370
420°C	2 900	1 744	1 663
450°C	2 851	2 929	0 973
475°C	3.540	5.070	0 698



Butadiene for purposes of polymerisation must be of adequate purity The formation of by products has therefore to be minimised and a working temperature of 420°C, is therefore most suitable

Further work is in progress and details will be published elsewhere

Our thanks are due to Sir J C Ghosh and Professor B Sanjiva Rao for their keen interest in this work

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ON THE STABILITY OF VITAMIN A

Vitamin A is not stable on storage and its deterioration is generally ascribed to the gradual oxidation of the molecule As the vitamin is usually present in some fat or oil, th s oxidation is believed to be due to an onset of oxidation in the unsaturated molecule of the latter substance An earlier observation of Basu[1] tends to indicate that the deterioration of vitamin A cannot be accounted for by the above change only Vitamin itself is an unsaturated body and undergoes oxidation The susceptibility to this oxidation is again being found to be dependent on its chemical nature as the vitamin A in the form of an ester is more resistant[2,3] than the free vitamin which is an alcohol The oxidation of vitamin in any food fat or medicinal oil may, however, be controlled to a considerable extent by incorporation of some suitable anti-oxidant [1,4,5] In order to find out its cause and nature of oxidation, an investigation has been undertaken and the results so far obtained, are being recorded here

A vitamin concentrate containing 2×10^5 I U per gm was incorporated in liquid paraffin (B P), purified arachis oil, glyceryl mono laurate mixed with paraffin oil (1 1) and ethyl oleate in such a way that the initial concentration of the vitamin comes to near about the potency of oleum vitaminatum (B P 1932) Air (4 c c per second) purified and dried, was passed through the systems kept in a thermostat adjusted to 33°C in the case of the latter two substances and at room temperature (28 29°C) in the former two cases The vitamin A potency was determined with a vitameter A (Adam Hilger) Another series of experiments were also made with similar systems but with the incorporation of the antioxidant propylgallate (0 05%) or methyl hydroquinone (0 05%)

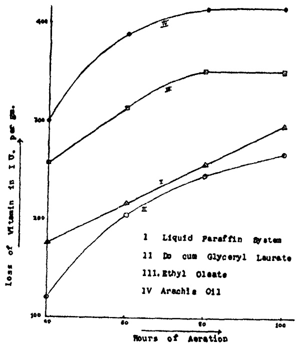
TABLE

Loss in Vitamin Potency on Aeration

System	Hours of Aeration	Fall of Vitamin A potency in I U/gm of the preparations		
		(a) Without Antioxidant	(b) With Pro pyl gallate	(c) With methyl Hydroquinone
Liquid	33 5	168	162	164
Paraffin	64 0	211	236	230
(I)	90 0	270	288	—
Glyceryl	33 0	83	19	14
Monolaurate	54 0	194	39	34
cum	88 5	265	51	50
Paraffin	119 0	274	67	70
(II)				
Ethyl	22 5	203	47	—
Oleate	43 5	270	78	61
	74 5	350	89	71
(III)	105 5	348	100	98
Arachis oil	24 5	201	44	98
	49 0	348	143	203
(IV)	66 5	412	200	223
	87 5	416	201	—

From column (a) of the table and the graph it might be noticed that the amount of vitamin A destroyed in a liquid paraffin system (I) increases steadily with the time of aeration, whereas in all other systems containing fatty acid esters this amount increases at first but tends to become constant with time The incorporation of an antioxidant(propyl gallate or methyl hydroquinone) has apparently no effect in the paraffin system, but in all other cases this exerts an appreciable protective action on the vitamin The anti oxidants are again exerting their maximum effect in saturated gyceride system (II), less so in unsaturated fatty acid ester (system III) and still less in natural fat (system IV) The two antioxidants studied do not appreciably differ in their power of retaining the potency of vitamin A in the latter three systems, but propyl gallate, however,

imparts a tinge of colour to the preparation most probably due to its reaction with some trace metallic elements



If the inherent characteristic of Vitamin A undergoing deterioration on oxidation be controlled by some chemical and/or physical means the problem of its deterioration in natural or fortified edible products may be more easily controlled With this end in view the investigation is being further continued with vitamin A alcohol as well as its ester in simple esters of saturated fatty acids and also in liquid paraffin system containing glycerides and esters of saturated and unsaturated fatty acids

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DIELECTRIC CONSTANT AND MOLECULAR STRUCTURE OF HEXACHLOROCYCLOHEXANES

Hexachlorocyclohexane, formed on addition of chlorine to benzene in presence of sun light, is a mixture of a number of isomers, out of which the γ isomer melting at 112 5°C possesses outstanding insecticidal properties[2] From the commercial mixture we have isolated four isomers α, β, γ and δ melting at 158°, 309°, 112 5° and 138°C respectively by fractional crystallisation from methyl alcohol and measured the dielectric constants and densities in various solvents The electric moments have been calculated by applying the new simple equation[1]

$$P = (\epsilon-1)\frac{M}{d},\ P_E = (n^2-1)\frac{M}{d}$$

and $P-P_E = \dfrac{4\pi N b^2}{KT}$ for pure liquids and

$$P_{12} = \frac{(\epsilon_{12}-1)(M_1 f_1+M_2 f_2)}{d_{12}} = P_1 f_1 + P_2 f_2$$

and $P_2-P_E = \dfrac{4\pi N b^2}{KT}$

for solutions The results are summarised in the following table

Isomer	Solvent	6 10¹⁸
α	Benzene	1 73
	Dioxane	1 70
β	Benzene	0 00
	Dioxane	0 00
γ	Pure molten liquid	2 58
	Benzene	2 53
	Carbon tetrachloride	2 50
δ	Dioxane	2 58
	Benzene	0 00

In β isomer all the six chlorine atoms are equatorial (parallel to the plane of the ring) whereas in δ the chlorine atoms 1,2,4 and 5 are equatorial and, 3′ 6¹ are polar (perpendicular to the plane of the ring), all the six forming opposite pairs Thus β and δ isomers are symmetrical molecules and have zero moment The moment 2 5 D of the γ isomer, which has five equatorial and one polar chlorine atom is explained as a vector of two C Cl bonds at tetrahedral angle, the remaining four bonds cancelling out The moment 1 7D for the α isomer melting at 158°C is explained on the basis of the flexible boat form, which has the highest energy content and which also forms 70% of the product Experiments are under the way to convert this flexible form into other forms by catalytic methods The configuration with four equatorial (1,2,3,4) chlorine atoms and two polar (5′, 6′) chlorine atoms ascribed by Slade to the α isomer, appears to be the probable configuration of ϵ isomer

Full paper will be published elsewhere

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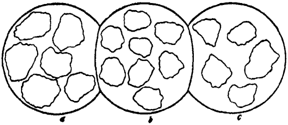
SHAPE ANALYSIS OF QUARTZ SAND GRAINS IN SOME GONDWANA SANDSTONES

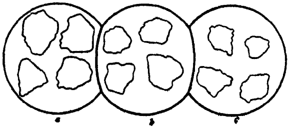
An account of mechanical analysis of Gondwana sandstones of the Raniganj, Panchet and the supra Panchet stages of the Raniganj Field has been communicated elsewhere[3] These grades were utilised for mineral and shape analysis After separating the heavy minerals by bromoform, the lighter residues were carefully split and mounted for measurement of the quartz sand grains.

Individual grains were projected and drawn with the help of a camera lucida, and the ratio of the area of each individual grain to the area of the smallest circumscribed circle, was determined This ratio was designated by Tickell[4] the Roundness Number As pointed out by Pettijhon[2], however, Tickell fails to distinguish between roundness and shape Roundness, as shown by Wadell, is not necessarily a function of the shape, and grains having the same sphericity (see below) may vary widely in roundness Tickell's number could thus be called the 'sphericity number' As will be evident the measure gives a close approximation to the value of sphericity of the grains, *i e*, the degree to which the grains approach spheres in shape The sphericity could best be measured by comparing volumes (Wadell in large grains) In smaller grains Wadell compares the diameters of the smallest circumscribed circle, and of the circle of an equal area This is similar to Tickell's measure, and in equigranular minerals like quartz this gives a very close approach to the true sphericity



a *b* *c*

FIG 1



a *b* *c*

FIG 2

The sphericity numbers of the grains measured lie within 0 577 to 0 89 The values of the average sphericity numbers of the four samples examined and the mean deviation are given in the table. As will be seen in the table the deviation is not very great

TABLE

Specimen	Average Sphericity No	Mean Deviation
39 (Fig 1, *a* and *b*)	0 723	0 074
55 (Fig 2, *a* and *b*)	0 677	0 058
45g (Fig 1 *c*)	0 713	0 060
46a (Fig 2 *c*)	0 618	only 4 grains were measured

A systematic study of the sphericity and its correlation with size is in progress and will be published elsewhere, together with the detailed work on mechanical analysis

The length and breadth of individual grains were measured with the help of a micrometer ocular The length was plotted as abscissa and the ratio breadth length as the ordinate (Hagerman[1]) It has been found by Hagerman that the scatter diagram plots within a recognisable field, the shape of which depends on the condition of deposition and was found to be characteristic of different horizons The Hagerman scatter diagram could be utilised for the correlation of b l ratio and the maximum length to study its bearing on the process of sedimentation on a regional basis It is thus suggested that the correlation coefficient (r) should be determined to have a definite measure of the correlation from measurement of grains from one horizon, or from a zone which is likely to reveal the nature and direction of transportation There could be no objection to the application of the correlation coefficient in this case as both the values are measurable quantities that vary continuously and are independent of each other

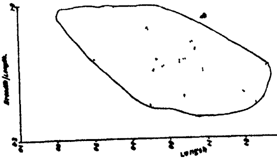


Fig 3

The scatter diagram (Fig 3) of the grains from the sandstones studied describes a roughly elliptical area, the limits of b l lying within 0 55 to 0 95 and with few lying beyond Within this limit again there is a marked concentration between ratios 0 65 to 0 95 The correlation coefficient was determined and a fairly high negative correlation (=0 80) was obtained That is to say within the limits of the b l ratio in the measured cases there is a definite tendency for the smaller grains to be equiaxial than bigger ones, though the rate of

change of this ratio is not very great In this study the measurement grains of all the samples were plotted together

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[1] Hagerman T H *Geografiska Annaler, 18*
[2] Krumbein and Pettijhon, Manual of Sedimentary Petrography
[3] Sen and Raychaudhuri, *Q J G M S*, *20*, No 3, (*in press*)
[4] Tickell F G, Examination of Fragmental Rocks
[5] Wadell H, *Journ Geol 40, 41, 43*

EFFECT OF GAMMEXANE ON THE ROOT TIPS OF *CORCHORUS CAPSULARIS* LINN

Variation in a crop is necessary for any improvement by selection or otherwise A search for new agents which induce mutation is made because of their theoretical and practical applications Several drugs and compounds are already known to induce chromosomal changes [1,2] "Gammexane" dust with the active ingredient, gamma isomer of Benzene hexachloride, is considered likely to produce such abnormalities and is tried on jute to see whether it can be used to induce variability

Seeds of *Corchorus capsularis* (D154) were sown in petri dishes for germination For rapid and uniform germination, they were treated with concentrated H_2SO_4 for five minutes and washed thoroughly before sowing When the radicles had grown to about 0 5 cm in length, "Gammexane" dust (D 025) in water was poured into the petri dishes Solutions of 1 0% (1 gm in 100 cc of water), 0 5%, 0 1%, 0 05% and 0 01% were used Solubility of "Gammexane" is very slight and so the mixture was shaken well before pouring and the mixture with suspended particles was poured in They were treated with 1 0% for 24 hours and 48 hours for the rest In all the cases there was swelling of root tips after 24 hours except in 0 1% The seeds were washed thoroughly and were allowed a recovery period of 16 to 20 hours in each case The lot treated with 1 0% solution appeared to be slightly toxic as some radicles turned brownish and appeared unhealthy

The root tips were fixed in Cr AF solution between 10 A M and 1 P M and stained with Gentian Voilet

The usual features associated with polyploidising drugs were noticed Cells were in many cases bi-

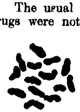

Fig 1 Diploid (untreated) metaphase plate $2n = 14 \times 3500$

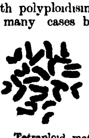

Fig 2 Tetraploid metaphase plate with 0 5% treatment $2n = 28 \times 3500$

or multinucleate The chromosomes in general were more condensed than the normal From clumped nuclear material in extreme cases to compact metaphase polyploid plates were seen While metaphase plates with higher numbers were noticed, tetraploid plates with $2n=28$ (Fig 2) with some diploid number ($2n=14$, Fig 1) was the common feature The presence of diploid plates could be seen more frequently in lower concentrations Spindle formation was inhibited resulting in polyploid numbers The chromosomes in several cases were scattered In such cases those groups of chromosomes appeared to organise into separate nuclei Two tetraploid metaphase plates in the same cell were observed This was due to lack of co ordination between karyokinesis and cytokinesis as the chemical affected the cytoplasm mainly

During the progress of our observations[3], Kostoff[4] reported the polyploidising nature of insecticide, Agrocides 3 7 and fungicide "granosan," the active ingredients being hexachlorocyclohexane and Ethyl mercury chloride respectively Polyploidy was induced with hexachlorocyclohexane and polychlorocyclane sulphate by Quidet and Hitier[5] in *Nicotiana tabacum* stem tips with 8% dust and *Allium cepa* roots with 0 01% The latter observed multinucleate cells and rarity of cell divisions

While the genetical aspect is being investigated, it may be pointed out that the polyploidising effect of insecticides "Agrocides" and "Gammexane" on root tips demands caution in their usage As Kostoff[4] points out degeneration in pure lines may occur Secondly, the presence of "Gammexane" in large quantities with seeds when sown for germination may inhibit proper germination and may retard growth Smith[6] finds that residual benzene hexachloride in soil exerts a harmful effect on the growth of seedlings, especially to their root development He finds that the effect is seen with 0 0025% in oats, 0 02% in wheat and in cress markedly at 0 05% In the concentrations used in this experiment, jute seeds are markedly affected with 0 05% in petri dishes The effect of "Gammexane" on seeds with thin seed coats if they are kept in contact for a long time as in stored grains and of other gammexane types such as P 520 and L G 140 are to be investigated

Gammexane, as a polyploidising agent adds to the long list of agents which induce polyploidy Its relative cheapness and easy availability can be utilised with advantage to replace costly chemicals like colchicine

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SCIENCE AND CULTURE

A Monthly Journal of Natural and Cultural Sciences

Vol 14 JUNE 1949 No. 12

RECONSTRUCTION OF AGRICULTURAL FINANCE IN INDIA

ELSEWHERE in this issue is published an elaborate article on the organizational structure and mode of operation of Government credit for farmers in the United States of America This lends itself as an appropriate occasion to review the agricultural credit situation in our own Indian Union, and to suggest ways and means to improve, or build anew agricultural finance structure, which is now in a moribund condition, in the light of experience gained in the agriculturally advanced countries

Improvement of methods of agricultural operations as a means of increasing farm produce and yield is universally accepted, and special attention need be devoted to any measure that is likely to increase our total agricultural production in the present critical situation the country is faced with in respect to food crops and such industrial crops as jute, cotton, etc To bring about any improvement or adoption of better farm practices presupposes investment of capital But 90 per cent of our cultivators are too poor to possess themselves of the money that need be invested for the purpose Not to speak of capital investment in modern agricultural equipments and sprayers for application of protective insecticides and fungicides, he has not even the small surplus cash to buy the seasonal requirements of fertilizers and improved seeds He is literally steeped in perpetual indebtedness The Simon Commission in their Report[1] did not fail to take notice of the depth of poverty in which the cultivator is living

"The low standard of living to which the mass of India's population attain is one of the first things that strike a Western visitor Wants are few, diet is simple, climate is usually kind, and a deep rooted tradition tends to make the countryman content with things as they are But the depth of poverty, the pervading presence of which cannot escape notice, is not so easily realised."

[1] Report of the Indian Statutory Commission—Vol 1 (Survey) 1930, p. 384.

Nearly two decades have passed by since the Simon Commission reported, yet no improvement in the material condition of the cultivator or, for the matter of that, the masses is evident His condition can be elevated only if he can be helped by some Government agencies to find means to increase his production through investment on farm improvement measures Nothing better need be said than to cite here the very pertinent observation made in that respect in the *Report of the Royal Commission on Agriculture in India*, 1928 (p 416), while discussing the question of "Finance of Agriculture in India"

"In a country in which holdings are so small as they are in India, the question of providing the cultivator with the capital he requires and with guidance as to the manner in which it should be spent if he is to utilize his land to the best advantage and to maintain an adequate standard of living, becomes one of crucial importance It is clear that in the adoption of some form of intensive cultivation lies the greatest hope of enabling the cultivator to meet, from his small holding, his own needs and those of his family Intensive cultivation is, however, as a rule, only possible where capital has been invested in the improvement of land. Throughout its history, the cultivating conditions of India have been vastly improved and its gross production immensely increased as a result of the investment of capital in this way "

In discussing the rural finance in India, the Central Banking Enquiry Committee in their Report (Vol 1 p 46) observed of the greater necessity of credit for the cultivator *vis a vis* the industries, and commented on the absence of credit institution that can undertake the enormous task of providing the cultivator with necessary credit The Central Banking Enquiry Committee, therefore, recommended that in the absence of alternative credit facilities "special arrangement through State assistance to extend cheap facilities for credit to cultivators" be made

The question of rural credit, especially credit for agricultural purposes, also received a considerable attention by the various Provincial Banking Enquiry

Committees appointed from time to time An up-to-date summation of the present position in the field of agricultural finance has been made in the report[2] issued in 1941 by the Agricultural Credit Department of the Reserve Bank of India All those Committees were unanimous on the urgency of providing credit to the cultivator and the necessity of considerably improving the entire structure of agricultural finance machinery In the Final Report of the Famine Enquiry Commission published as late as 1945, the Commission discussed upon the most inadequate nature of the availability of credit for the cultivator and reported that

"the replies received from the Provincial Governments indicate that, apart from the provision of credit under the Grow More Food campaign, the position (of agricultural credit) continues to be the same as in 1931" (p 292)

The question now comes up Should the agricultural credit situation be let to drift as it is, or should attempts be made to revitalize, if possible, and to reconstruct, if necessary, the whole structure of agricultural finance to the extent that it may be an effective instrument in the present drive for increased agricultural production in order to help the country attain self sufficiency in respect of farm produce and to improve the earnings of the masses and thereby to raise their standard of living?

The supply of rural credit, particularly agricultural credit required by the middle and poorer classes of cultivators, was once wholly provided by the rural money-lender The usefulness of this institution was admitted by the Royal Commission on Agriculture in India (1928) and the Central Banking Enquiry Committee of 1931 The private money lender was considered an indispensible feature in the existing rural and agricultural finance The method of business was found very simple and highly elastic He maintained a close touch with the borrower and his local knowledge and presence on the spot enabled him to accommodate persons without tangible assets and yet protected himself against losses But the greatest evil in that system has been the very high rate of interest charged on the loan advanced Further, the money-lender, in many cases, manipulated the affairs in such a way as to secure possession of debtor's saleable products at a low price or the eventual acquisition of his land

Several legislative measures in the form of money-lenders' acts, agricultural debtors' acts, etc, were passed in most of the Provinces with a view to ameliorate the condition of the debtor cultivator These enactments virtually effected to scale down very considerably the rural and agricultural indebtedness, which was at one time estimated to be of the magnitude of 900 crores of rupees The money-lender was hard hit, and he withdrew almost completely from the lending business In the absence of alternate provision of credit from the State, these legislative measures did not improve the debtor's position, rather he was left worse off than before An useful institution was destroyed on account of certain of its bad features but nothing was done to fill up the void left by its disappearance

The only other institution that was intended to serve out some benefit to the cultivator has been the co-operative banks and societies The published statement[2] (p 7) showed that the co-operative societies had a loan of Rs 23 14 crores outstanding of which loans of the amount of Rs 10 71 crores (i e, nearly half) were overdue The accumulation of heavy overdues and freezing of the assets of the societies naturally resulted in the clogging of their business and paralyzed the working of the co-operative movement over the whole country These facts prove that the void left by the disappearance of country bankers was not filled up by co operative banks except on a homoeopathic scale

Besides advisory services and a few minor concessions, the part played by the Central or Provincial Governments in co operative credit has been very insignificant Of the total working capital of Rs 13 41 crores of the Provincial co operative banks in India at the end of the year 1939 40, only Rs 61 lakhs (i e, 4½ per cent of the working capital) were advanced as loans from the Government[2] (p 13)

The Reserve Bank of India is empowered under the Statute to provide assistance to agriculture on the usual central banking principles by discounting bills drawn on the Provincial co operative banks for amounts needed to meet the seasonal needs and marketing of crops for a maximum period of 9 months Only two Provincial co-operative banks have taken advances of small amounts from the Reserve Bank on a few occasions Other Provincial co-operative banks fell short of the stipulation laid down to qualify for such advances from the Reserve Bank

Nothing can be done better than to quote here the following lines from the Reserve Bank of India Report[2] (p 15) on the present position of co operative agricultural credit in India

"The general survey of the recent position of the co operative movement in respect of agricultural credit situation showed that urgent measures were necessary in several Provinces to save the movement from collapse and to restore the confidence of the public in it"

The only other avenues of credit available to the cultivator are (1) The Land Mortgage Banks, (2) The Land Improvement Loans Act of 1883, and (3) The Agriculturists' Loans Act of 1884 It is only in Madras that the technique of land mortgage banking has developed to any extent The Madras Central Land Mortgage Bank, established in 1929, is the only one of its kind in India which is running on a very sound foundation The operation of the Agriculturists' Loans Act is practised, if ever, only on occasions of distress arising from general crop failure from drought, flood, earthquake, etc The Land Improvement Loans Act has been in existence for a long time as a "dead letter."

[2] Review of the Co operative Movement in India, 1939 40

The above brief survey will have shown conclusively that the loan provisions under the Land Improvement Loans Act and the Agriculturists' Loans Act are almost defunct, the supply of credit from co-operative organizations are in a moribund condition, while the supply of agricultural credit so far provided in the main by the private money lender has dried out

Loud talks are being given by those in authority of their resolve to make the Indian Union self-sufficient as regards food-crops by the end of 1951 We are accustomed to such loud talks since the inception of the Grow More Food campaign for about 10 years, but have failed to detect the inception of much sound measures for increasing the yield of food stuff in the country Nay, it is our experience that the more empty headed a minister is, the louder he talks, and the less he is able to achieve The talk that India can be rendered self sufficient in food production by 1951, appears to us utter rot when we find that no adequate provisions are yet afoot to provide the cultivator with loans, in cash or kinds, to enable him to spend on improvement measures calculated to produce 'two blades of grass where one grew before '

In the United States of America the material conditions of the farmer are admittedly much superior to their opposite numbers in India Those of us who have had opportunities to live for some time with farm families in the U S A have marvelled to see their high standard of living—a standard which in public utility services and private conveniences can hardly be reached even by the upper-middle class families of the Indian society Yet conditions in the U S A were not always much better than in India, and even as late as 1930, conditions of agricultural population in the Tennessee Valley and other backward areas were almost as bad It is not "loud talks" by ministers which have improved the conditions overnight, as is promised in this country, but a series of sound measures gradually introduced over decades

In spite of the great prosperity of farmers in the U S A, Government think it expedient to make every year adequate loan provision for farm use Even when the U S A farming is passing through high prosperity, 1,207 and 997 million dollars (i e, 400 and 300 crores of rupees) have respectively been provided in the budget estimates for 1949 and 1950 under short- or long term "Loans and Investment Programmes to Aid Agriculture "[3] And so far, since beginning around the year 1917, the U S A farmers have enjoyed the benefit of loans from the Government to the estimated amount of 20 to 25 billion dollars (i e, 6,500 to 8,500 crores of rupees)

The effect such stupendous sums have had on the agricultural progress and prosperity that obtain today in the United States can better be imagined than described There now exists a very elaborate and effective organization under the Department of Agriculture of the U S Government This credit organization in the U S A has developed through trials and errors over the last three decades and has been perfected through past failures and experiences to a high degree of efficiency and a high measure of success in the field of agricultural credit operations

The Royal Commission on Agriculture in India of 1928, the Central Banking Enquiry Committee of 1931, and the recent Famine Enquiry Commission have all noted and deplored the absence of any distinction between loans made for (1) immediate productive purposes and seasonal needs, (2) those incurred for long-term purposes for farm land improvement, (3) the medium-term for farm machineries, and (4) loans to enable the farmer to hold on his produce for better prices later The credit organization under the U S Department of Agriculture has provision for each and all of the above counts and many other items as well

It is, therefore, suggested that on the model of the credit structure under the U S Department of Agriculture, a separate Directorate of Agricultural Loans be established under the Central Department of Agriculture The Directorate should have the following divisions

(1) *Division of Farm Mortgage Credit*, which will advance loans for purchase of new farm land and extension and improvement of existing ones Such loans are to be repaid in semi annual amortized instalments over 20 to 25 years These loans are to be advanced on the recommendation of local National Farm Loan Association, which should be composed only of the borrower farmers As soon a loan is sanctioned but before the loan amount is paid to the borrower, the latter should become a member of the local Loan Association by buying shares of the Loan Association equal to 5 per cent of his loan amount on the valuation of the land declared by a Federal land appraizer of the land to be mortgaged, 65 per cent to 70 per cent of the valuation of the land can be advanced as loan

(2) *Division of Production Loan*—Short-term loans up to a period of 12 to 18 months should be advanced for purposes to financing current production, to buy fertilizer, seed, and other seasonal needs, and to pay for farm machinery and equipment or to meet any normal expenses of the farm and the farmers' home needs This loan can be advanced on the security of the farm land, failing which a lien on the crop, livestock, or equipment which produces the income to repay the loan, should be considered sufficient Before this type of loan can be advanced, the loan application should come through the local Loan Association as stated above,

(3) *Division of Water Facility Loan*—For irrigating, sinking tube-well, or digging tanks for irrigation purposes loan should be advanced to build, improve, or repair needed water facilities on the farm Such loans should be of medium-term, say for 5 to 10 years.

[3] Budget message of the President to the U. S. Congress, January 10, 1949.

(4) *Division of Loan for Farmers' Co operatives*—A separate division should be in charge of loans required by farmers' co-operatives In this case loans should be advanced against adequate securities (such as movable or immovable properties of the co-operative) for purposes of processing, preparing for market, marketing farm products, purchasing and grading of farm supplies, etc

Lastly, to make such a proposed Directorate of Agricultural Loans really serviceful to the common cultivator red tape should be avoided Numerous complaints of delay in dealing with loan application were heard before, and their truth was admitted by the Royal Commission on Agriculture in India Unless all out attempts are made to take decision on a loan application within a few days of its submission and loan money is made available in good time to buy the cultivator's requirement of seeds, fertilizer, etc, the loan will fail to serve the purpose for which it was really meant

GOVERNMENT FINANCING OF AGRICULTURE IN THE UNITED STATES

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PROVIDING adequate credit to farmers has always been quite a problem to all countries In years of agricultural prosperity, loans from private sources are not difficult to obtain, but in lean years, when necessity for agricultural credit is all the greater, private lenders and commercial loan companies who operate on profit motives alone, become unduly apprehensive of the future economic situation and fight shy of investing any further money in agricultural loans Furthermore, private operators do not hesitate to take full advantage of the pecuniary helplessness of the farmer to charge excessively high rates of interest and thereby ruin the latter economically

The money lender's acts, passed by the various provinces of the Indian Union in the late 1930's, tried to remedy the situation by putting a ceiling on the rate of interest As a result of their enactment, the loan operators withdrew from the lending field In the absence of simultaneous and alternate provisions for agricultural loans, the farmer's condition has probably gotten worse than before, whatever opportunities for loans he had previously were completely with drawn from him

More than a decade has since passed, yet no concrete attempts have so far been made to make available to the farmer loans for agricultural purposes on easy and cheap terms Now that we have our own National Government, we cannot throw blame elsewhere for the most unfortunate and pitiable condition of our farm population, who comprise more than 70 per cent of the country's total Farm prosperity will not return unless the farmer is able to invest in farm improvement measures The farmer cannot be expected to invest for improvement and productive purposes unless he has himself the money for it or is provided with sufficient credit to do so

In the United States the condition of the farmer is far superior to that of his counterpart in India, his standard of living is usually higher than even our middle-class salaried group He is not usually so helpless as to have no money for buying improved seed, necessary fertilizer, etc Yet the Government of the United States has not left him to his own initiative and at the mercy of private creditors to obtain funds for his agricultural operations Under the U S Department of Agriculture there exist a few agencies charged with the responsibilities and functions to provide loans for agricultural purposes to stock men, farmers, and farmers' cooperatives at a low rate of interest and on easy terms

Below is given a short account of the organization, operation, and administration of the system of agricultural financing that has been developed in the United States in the course of the past 25 years and which has been so effective in solving the probelm of agricultural credit in that country It is hoped that this account might provide a few suggestive ideas in solving our own agricultural credit problems

The agencies of the U S Department of Agriculture concerned with the supply of agricultural credit to the farmers and their cooperatives are (1) Farm Credit Administration, (2) Farmers Home Administration, and (3) Commodity Credit Corporation of the Production and Marketing Administration [1] Each of the above agencies is responsible for the management of a particular class or classes of agricultural loans

FARM CREDIT ADMINISTRATION

Farm Credit Administration was created by an executive order effective May 27, 1933, which provided for the consolidation within one organizational unit of the powers and functions of all Federal agencies dealing primarily with agricultural credit The Farm Credit Administration became a part of the U S. Department of Agriculture in July, 1939.

[1] *Science and Culture* 14, 441-446, 1949.

From the beginning of its operation in 1933, through June 30, 1947, the Farm Credit Administration, through the banks and the corporations under it, has provided 7,337,000 farmers and farmers' coopera tives with total loans of 13,769 million dollars* to finance farm operations, marketing, and farm ownership [2] On June 30, 1947, 1,687,000 farmers and their cooperatives were actually using 1,718 million dollars loaned out to them under the auspices of the Farm Credit Administration

For facility of loan operation, the United States is divided into 12 Farm Credit districts In each dis trict there are four major credit units, each serving a separate and distinct purpose, but located usually in the same building, in the headquarters city of the district These organizational units are

I A Federal Land Bank which makes long term mortgage loans through local organizations known as National Farm Loan Associations, made up of borrowing farmers

II A Production Credit Corporation which guides, supervises, and partially finances local Production Credit Associations which make production loans to farmers and stockmen

III A District Bank for Cooperatives which makes loans direct to farmers' and stockmens' cooperatives

IV A Federal Intermediate Credit Bank which acts as a bank of discount to supply short term funds to local Production Credit Associations and farmers' cooperatives

1 Farm Mortgage Credit System

Farm mortgage loans are made available (*i*) to buy land for agricultural uses, (*ii*) to purchase equipment, fertilizer and livestock necessary for the proper operation of the mortgaged farm, (*iii*) to raise farm buildings and for the improvement of farm land, (*iv*) to pay off indebtedness of the borrower incurred for agricultural purposes, and (*v*) to provide necessary funds for general agricultural purposes

A farm mortgage loan is available to any citizen of the United States who is a farmer, in amounts from 100 to 50,000 dollars, but not in excess of 65 percent of the appraised normal time agricultural value of the farm mortgaged The rate of interest charged is 4 percent The amount of the loan is to be repaid in semi-annual amortized instalments, in 33 years in the case of livestock farms, and in 20 years in the case of crop farms (because of more rapid deterioration of the latter in case of improper care)

Such loans are also available to livestock corporations if all shares of the corporation are owned by persons actually engaged in raising livestock on the property to be mortgaged In all such cases, the owners of at least 75 percent of the capital shares must assume personal liability for the loan

A prospective borrower applies to the local National Farm Loan Association, which is entirely a borrowing-farmers' organization, on a simplified printed form with an appraisal fee of 10 dollars Soon after the loan application is received, the farm offered as security is appraised by a Land Bank appraiser, who is a public official in the employment of the Farm Credit Administration If the applicant has clear title to the property, the loan is sanctioned within 6 to 7 days on the basis of the approved value declared by the Federal appraiser

A loan is not actually made by the local National Farm Loan Association, but its acceptance is recommended by them to the Federal Land Bank in the district

National Farm Loan Association —It is entirely a borrowing farmers' and stock mens' association Every farmer who receives a farm mortgage loan becomes automatically a member of the local National Farm Loan Association and is required by law to own shares in the Association equal to 5 percent of his loan This amount is deducted at the time when the amount of the loan is received by the borrower These shares are held by the Association as additional collateral for the loan Purchase of shares in the Association entitles its holder to a vote in the meetings of the Association at which directors are elected and business is transacted, it further entitles him to saving and profits which may be passed back to him by the Association in the form of dividends As soon as a borrower fully pays off his loan, his shares in the Association are retired, and unless they are impaired, he receives par value for the shares he held

The members of the local National Farm Loan Association elect from among themselves 5 to 7 directors, the directors among themselves elect a loan committee of 3 men Two are from the directors and the third member, an outsider with technical knowledge, is appointed on a paid basis to the position of Secretary-Treasurer of the Association Before a loan is made, the loan application is to be signed by all the 3 members of the loan committee As a measure of assisting Associations to keep their lending on a sound basis, loans to officials and loans in excess of a specified proportion of an Association's paid in capital and guaranty fund must be approved by the Federal Land Bank of the district and, in particular cases, by the Farm Credit Administration

Besides the Secretary-Treasurer, who is a paid employee, no other directors or loan committee members receive any pay or compensation for the services they render to the Association

There were 1,280 National Farm Loan Associations under the 12 Federal Land Banks on June 30, 1947 During the fiscal year 1947, 1,218 of these Associations

* One dollar equals approximately 3¼ rupee

[2] *Fourteenth Annual Report Farm Credit Administration*, 1946-47, U S. Department of Agriculture.

declared dividends amounting to nearly 3 million dollars

Federal Land Banks—As mentioned earlier, the National Farm Loan Associations do not advance loans to farmers, neither have they necessary funds to do so The loan application is recommended to the Federal Land Bank in their district, and the Land Bank pays the borrowers

The 12 Federal Land Banks were organized in 1917 as semi government institutions with 8 million dollars of Government capital This capital was mostly repaid to the Government by 1926 With the break in the farm commodity prices and collapse of farm real estate values in the early 1930's, the Government in 1932 subscribed 125 million dollars in additional capital shares in the Land Banks With the return of farm prosperity beginning in the late 1930's the financial condition of these banks began to improve very considerably In line with the policy of the Farm Credit Administration and the Federal Land Banks to retire the Government's capital in these Land Banks as soon as the financial situation permits, all the Government capital had been returned to the Treasury by June 30, 1947, each of these 12 Federal Land Banks are now entirely owned by the National Farm Loan Association of borrowing farmers, and are managed, as before, under the Government supervision

Since their establishment the Federal Land Banks have made long term mortgage loans (up to 33 years) to a million American farmers, totalling more than four billion* dollars They have built up legal reserves and earned a surplus of 199 million dollars after meeting losses representing slightly less than 3 percent of the total loaned They have paid a total dividend of 54 million dollars to their shareholders, who are the farmer owned and farmer operated National Farm Loan Associations

Federal Farm Mortgage Corporation—During the depression years when all private finances were withdrawn from the lending field and it was almost impossible for farmers to get any loans, the Federal Farm Mortgage Corporation was established by an act of the U S Congress, January 31, 1934 It was empowered to issue and to have outstanding at any one time bonds not exceeding 2,000 million dollars, and (*i*) to invest its funds in land mortgage loans made under Section 32 of the Emergency Farm Mortgage Act of 1933, and (*ii*) to purchase from time to time for cash, such consolidated farm loan bonds at such prices and upon such terms as might be determined by the directors of the Federal Farm Mortgage Corporation, and to make loans to Federal Land Banks on the security of such consolidated bonds

Unlike the Federal Land Banks, the Federal Farm Mortgage Corporation is entirely Government-owned and operated

* One billion equals 1,000,000,000 (*i e*, a thousand million)

The amount of investment by the Federal farm Mortgage Corporation reached an all-time peak of over 761 million dollars in April, 1936 With the return of farm prosperity, there has since been less borrowing At the close of the fiscal year 1947, the total amount of loans outstanding has been reduced to 123 million dollars

2 Production Credit System

Short term production loans, running up to 30 months, are available to United States farmers and livestock men for the following purposes which can be paid for from farm income in such period These loans are available for any one or more of the following purposes (*i*) to finance current production, (*ii*) to buy fertilizer, feed, seed, labour, etc, (*iii*) to purchase livestock, machinery and, equipment of all kinds for the farm, (*iv*) to pay for land and building improvement, (*v*) to pay indebtedness or meet the educational expenses of himself or his dependents, (*vi*) to pay doctor's and hospital bills, rents, taxes, insurance premiums, and (*vii*) to meet any normal expenses of the farm and the farmer's home needs

For production loan, security is expected but not always essential If security is required, it is usually a lien on crop, livestock, or equipment which produces the income to repay the loan

A production loan is made available wihin 5 or 6 days after application, interest charged is 5 percent Each dollar bears interest only when actually used Thus, one may draw on a loan piecemeal or pay it back piecemeal, to suit one's own plan

Federal Intermediate Credit Banks—In response to widespread demand and general recognition of the need for short-term loans for production purposes, 12 Federal Intermediate Banks, with a capital of 60 million dollars were established in 1923 by an act of the U S Congress These Banks are entirely Government owned and-operated Since their establishment, the Credit Banks have paid Government franchise taxes totalling 7 million dollars, reserves, earned surplus and undivided profits totalled 35 million dollars on June 30, 1947

The Federal Intermediate Credit Banks act as banks of discount to supply short term funds required by Production Credit Associations, Farmers' Cooperatives, and similar other financial institutions

During the fiscal year 1947, credits of 1,179 million dollars were extended by these 12 Banks for the purpose of production loans 892 million dollars to the Production Credit Associations, 193 million dollars to the Banks for Cooperatives, and 94 million dollars to privately capitalized (agricultural) lending institutions Loans and discounts outstanding June 30, 1947, amounted to over 400 million dollars

During the 24 years of their operation, ending June 30, 1947, the Federal Intermediate Credit Banks

provided credit for production purposes totalling over 10 billion dollars

The Federal Intermediate Credit Banks obtain the major portion of funds they use in lending operations through sales to the investing public or commercial corporations, life insurance companies, etc, of consolidated collateral trust debentures All the 12 Federal Intermediate Credit Banks are jointly and severally liable for their obligation

Production Credit Corporations—The 12 Production Credit Corporations, wholly Government owned, were established, one in each district, in 1933 with an aggregated available capital from Federal funds not exceeding 120 million dollars These Corporations organize and capitalize, as far as necessary, by purchasing non voting shares in the Production Credit Associations in the districts so as to give a start to the local Production Credit Association A major function of these Corporations is to give guidance, supervision and assistance to the Production Credit Associations located in the respective districts, in their credit, operating, and membership activities

The paid-in Government capital of these Corporations stood at 92 million dollars on June 30, 1947, of which 41 million dollars was invested in the non-voting shares of the Production Credit Associations and the rest (51 million dollars) was invested in U S Government bonds

Since their creation in 1933, the Corporations have accumulated an earned surplus of over 16 million dollars and have repaid over 38 million dollars of the Government capital to a revolving fund in the United States Treasury

Production Credit Associations—Neither the Federal Intermediate Credit Banks nor the Production Credit Corporations make any direct loan to the farmers The farmers receive production loans through their local Production Credit Associations As soon as a loan is sanctioned to a farmer, 5 percent is deducted from the amount of his loan as the value of his shares in the capital of the local Production Credit Association to become a member of the latter so as to be eligible to obtain a production credit loan On the repayment of his loan he may withdraw the par value of his shares in the Production Credit Association, but his shares are not compulsorily retired as in the case of the Farm Loan Association membership If he chooses to retain his shares in the Production Credit Association, he maintains the same privileges as any other member and is entitled to dividends, if and when declared

The members, each having one vote, elect from among themselves a board of 5 directors The directors themselves elect 2 of them and appoint an outsider on a paid basis as Secretary-Treasurer, to form a loan committee of 3 Usually the Secretary-Treasurer of the local National Farm Loan Association is appointed to act as the Secretary-Treasurer of the local Production Loan Association. Both these associations of a locality usually occupy the same office space and use the same equipment as a measure of economy, the cost of office maintenance and the pay of the Secretary-Treasurer and his clerk is shared by both the associations

For the year ending June 30, 1947, 237,881 production loans totalling over 680 million dollars were advanced to farmers and stockmen members of the Production Credit Associations, On that date there were 504 Production Credit Associations distributed over the United States with a total membership of over 400,000. The 400,000 farmer shareholders, on June 30, 1947 owned 42 million dollars of the capital of the Production Credit Associations compared with 40 million dollars worth owned by the Production Credit Corporation (*i e*, the U S Government)

Since 1933 the Production Credit Associations have loaned out to member farmers nearly 6 billion dollars for crop and livestock production purposes,, and have accumulated reserves of over 43 million dollars The net losses amount to about 1/12th of 1 percent of the total cash loaned

3 Credit System for Farmers' Cooperatives

To provide a source of credit for farmers' cooperatives on a sound business basis, 12 district Banks for Co operatives and a Central Bank for Co operatives (at Washington, D C) were established by the U S Government in 1933 The district Banks serve eligible borrowers (*i e*, farmers' cooperatives) in their respective districts Cooperatives operating beyond the jurisdiction of one district are served by the Central Bank for Cooperatives at Washington, D C

Farmers' cooperatives engaged in (*i*) processing, preparing for market, handling, or marketing farm products, (*ii*) purchasing, testing, grading, distributing, or furnishing of farm supplies, and (*iii*) furnishing farm business service, are eligible for loans from the Bank for Cooperatives To prevent misuse of such Government funds, it is enjoined that the cooperatives are operated for the mutual benefit of their members and not do more business with non members than members

Type of Loans Three separate types of loans are available to farmers' cooperatives

(a) Commodity Loans These loans are made on the security of wheat, cotton, and other farm products These loans are also available for financing farm supplies such as feeds, lime and fertilizer Each commodity loan must be secured by a first lien on farm products or supplies, which must have sufficient value in themselves to fully secure the loan The commodity loans are for the shortest term, and are generally repaid from the sale proceeds of the particular commodity or supplies The rate of interest for commodity loans was 1¼ percent in 1947

(b) Operating Capital Loans They are made to supplement the cooperatives' own capital funds during times of peak seasonal activity These loans

are for relatively shorter duration Security may or may not be required depending upon the term of the loan, the financial condition of the borrowing cooperatives, and other factors These loans are generally repaid by the end of the marketing of the product in question Interest charged for this type of loan is 2½ percent

(c) Facility Loans They are available for the purpose of financing or refinancing the purchase of land, building, fixed equipment for use in carrying on the business of the cooperatives These loans are to be secured by a first mortgage on the property with such additional collateral as necessary No such loan is to exceed 60 percent of the appraised value of the security offered These loans are repaid in instalments, usually in 10 years, and are limited by law not to exceed 20 years Facility loans are given on an interest of 3½ percent

A farmer's cooperative when borrowing from a Bank for Cooperatives is required to buy at the time the loan is effected shares in the Bank equal to 5 percent of the loan, except in the case of commodity loans, when the requirement is 1 percent of the amount loaned After a loan is repaid, a cooperative may retain the shares in the Bank, or, if so desired may receive back the par value of the shares held by it

Banks for Cooperatives The 13 Banks for Cooperatives had 178 million dollars of the Government-capital funds on June 30, 1947 A plan is being worked out to make these Banks for Cooperatives, as the Federal Land Banks are now, entirely owned by the borrowing cooperatives

During the fiscal year 1947 the Banks for Cooperatives extended over 425 million dollars in credit to 1,271 farmers' cooperatives, 280 million dollars as operating capital loans, 24 million dollars as facility loans, and 120 million dollars as commodity loans

Since their organization in 1933, the Banks have provided credit totalling over 3 billion dollars to nearly 1,400 farmers' cooperatives with a membership of about 2½ million farmers They have built up nearly 45 million dollars in reserves and earned surplus Losses have amounted to only three-hundredths of 1 percent of the total cash loaned

Farmers Home Administration

It will be seen from the earlier account that most of the above Government-operated or -sponsored loans are made on the principle of loan against security Then, what's about the less fortunate farmers who have nothing to offer by way of security, or about people who want to take up farming as an occupation for themselves and their families but have no money to do so

In the scheme of agricultural financing, the needs of such poor farmers have not been overlooked The Farmers' Home Administration was created, on November 1, 1946, as an agency under the United States Department of Agriculture, charged with the responsibility of giving the poor farmer, stockman, sharecropper, and tenant "a start on the road to better farming and improved living for his family through supervised credit" from the Government

The Farmers Home Administration has offices in most rural communities over the whole country to help poor farmers who are unable to get credit from any other source and to assist the borrower in planning and adopting sound farm and home practices which are likely to promote success in farming and better home life

All Farmers Home Administration loans are made through the Administration's local offices A loan committee of 3 persons, at least 2 of them being local farmers, determines the applicant's eligibility for Farmers Home Administration loans, certifies the value of the land to be bought with the loan money, and reviews the borrower's progress in farming Character, ability, industry, experience in farming, and willingness to carry out farming operations under the advice and supervision of the technical personnel of the Administration constitute eligibility for the loan

Since these loans are for farming families who are unable to put up security to get loans from Farm Credit Administration or private lenders, security is not considered essential for loans under the Farmers Home Administration The borrower is asked for a mortgage on the chattels or the land he will buy, or the crops and livestock he will raise with the loan money But it is impressed upon the borrower that his own honesty, industry and character is the best security he can offer for his loan

Type of Loans—There are three types of loans available under the Farmers Home Administration

(a) Production and Subsistence Loan It is available (*i*) to buy equipment, livestock, feeds, seed, lime, fertilizer and other farm supplies, (*ii*) to meet family living needs, including medical care, (*iii*) to enable two or more farm families to buy or obtain the use of heavy machinery, high grade breeding stock and similar other services which they are unable to own alone

Not more than, 3,300 dollars can be borrowed by any one family during any year nor can the total outstanding loan exceed 5,000 dollars at any one time The loan is repayable in 1 to 5 years, interest charged is 5 percent on the unpaid principal

Production and Subsistence Loans were made to 105,073 families aggregating over 90 million dollars in the year ending June 30, 1947[3]

(b) Farm Ownership Loan This type of loan is available to buy a "family-type" farm,[4] or to improve

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[3] *Strengthening the Family Farm a report of activities of the Farmers Home Administration 1946 47* United States Department of Agriculture

[4] A productive farm furnishing the operator a full time job through the year, yielding enough income for the family's needs —but not so big that outside labor is hired, except perhaps at the peak of planting and harvesting seasons.

and enlarge a farm to make it into an efficient family type unit The maximum for such a loan is 12,000 dollars, interest is 4 percent on the unpaid principal, and the loan is repayable in amortized instalments over 40 years

Nearly 6,000 farmers were receiving farm ownership loans in 1947, advances made that year totalled 45 million dollars Cumulative farm ownership loans for the 10-year period ending June 30, 1947, stood at 293 million dollars

To encourage private capital investment, the Farmers Home Administration, under a new plan operative since July 1, 1947, insures mortgages on loans made by private lenders for purposes similar to those for which Farm Ownership Loans are made Insured mortgage loans are limited to 90 percent of the borrower's total investment in the farm, The borrower is to make a 10 percent down payment out of his own funds, or, in the case of farm enlargement or development, to have an equity equal to 10 percent of the loan money The prescribed rate of interest is 4 percent, of which 1 percent goes to the Farmers Home Administration for underwriting the loan in case of default of payment by the borrower and the remaining 3 percent is received by the money lender

For the year ending June 30, 1948, similar loans totalling almost 2½ million dollars were made by private lenders and insured by the Farmers Home Administration [5]

(c) Water Facility Loan It is available to farmers, ranchers, and incorporated water associations in the 17 States in the western U S A, where water is a real scarcity, to enable them to build, improve or repair needed water facilities such as wells, ponds, water distribution system, and small irrigation projects

The maximum repayment period on Water Facility Loans is 20 years, and the rate of interest is 3 percent

In 1937, 1,064 such loans were made to individual farmers and 14 loans to water associations, for a total of 1½ million dollars The cumulative figure for loans advanced under the heading so far runs to nearly 8 million dollars

Commodity Credit Corporation

No picture of Government credit available to farmers in the United States will be complete unless a brief reference is made to the activities of the Commodity Credit Corporation

The Commodity Credit Corporation is a Government owned and-operated organization of semi-commercial nature under the Production and Administration of the U S Department of Agriculture In 1938, the U S Congress authorized the Corporation to issue and have outstanding bonds, notes and debentures in any amount not exceeding 500 million dollars The borrowing power of the Corporation has since been increased by subsequent legislations, and today the Corporation is authorized to borrow up to 4,750 million dollars on the credit of the United States

The activities of the Corporation fall into 4 general categories (i) the agricultural commodity supply program to the United States Army, foreign governments, and international relief organizations, (ii) purchase of agricultural commodities abroad, of which the United States is short, (iii) export of surplus farm commodities to foreign countries, and (iv) "price support" The price support program of the Corporation makes non recourse loans available to producers on harvested corn, wheat, barley, oats, grain, sorghums, flax, seed, cotton, and potatoes

To be eligible for a loan under the price support program the producer files application for the purpose soon after harvest and before a specified date for each commodity If he is unable to sell his commodity at or above, parity prices as determined by the Corporation, a loan of 80 to 90 percent of parity price will be available to the producer if he will store the commodity for the Government in approved commercial grain warehouses or right on the farm of the producer in approved bins and cribs

During the year 1947, the Commodity Credit Corporation advanced over 765 million dollars against several such commodities [6]

Since its creation on October 17, 1933, through June 30, 1947, the Corporation showed a net gain of over 102 million dollars

Conclusion

It will be seen from the above brief account that since the start of the Government agricultural financing programs around 1920, several millions of American farmers and their cooperatives have employed Government sponsored loans, to an estimated extent of 20 to 25 billion dollars (6,500 to 8,500 crores of rupees) to improve farm equipment, to enlarge the farm area and other productive means These loans have been of tremendous help to the farmers themselves and their cooperatives to improve their own income and to provide a higher standard of living for their families It helped the United States in her march to prosperity by the release of tremendous buying powers of the farm population to keep the industry running to its maximum capacity These loans are helping, though not without profit to the United States farmers, to produce enough surplus food to save the lives of many millions of starving people of many nations today who are in desperate need of food from the United States

During each of the past several years the United States farmers and their cooperatives were using cumu-

[5] USDA. U S. Dept Agri, November 22, 1948

[6] *Review of Operations—Commodity Credit Corporation Fiscal Year 1947* United States Department of Agriculture; (mimeographed)

lated amount of nearly 3 billion dollars of Government-sponsored loans (exclusive of private loans) for agricultural and allied purposes One can well realize what a tremendous influence such stupendous loans have had on the agricultural progress and farm progress and farm prosperity that obtain in the United States today

Nothing will lead us anywhere near to improvement of agriculture in India unless and until necessary agricultural credit is made available to our farmers under the Government or similar agencies at a cheap rate of interest and without much red tape If the United States Government feels the necessity of extending a few billion dollars as agricultural loans every year in a country where capital is never so shy as in India, the sheer imperativeness of providing easy credit to Indian farmers can better be realized than described

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CITY PLANNING

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A city, like a living being, is an organic body It grows, it dies, it has health, it has sickness Like a human being or a plant, a city needs good care and planning for its healthy growth and spread

India is faced with the problem of redistribution of population evenly throughout the country It is roughly estimated that about eighty per cent of our people live in villages, and everyone knows what abject standard of living we have in our villages In fact, our villages have practically nothing to offer in modern living and in economic opportunities On the other hand, the few cities that we have are in a terrible state of overcrowding and confusion The city of Calcutta, for example, is now faced with the problem of accommodating population three times its normal capacity Its present population compares with that of Chicago, but Calcutta has neither the finance nor the planning organizations to compare with that large industrial city of America

Growth of industries and cities go hand in hand We need more cities in our country as much as we need more industries to grow And when we are planning for industrialization of India, we cannot afford to neglect the associated programme, namely, nationwide city planning Let us not get into the confusions and expenses of unplanned cities which ultimately tax on the vitality of the nation We can, if we are wise, take advantage of the experience of other countries in this important phase of nation building by organizing planned cities where people can work, play and grow like human beings to love their home and their country "Love of home and love of country are synoymous terms Without it, no country can be virile, no country can long survive "[1]

Purpose of City Planning

According to Henry V Hubbard of the Harvard School of City Planning, "City planning has become to be recognized as a great social movement, rooted in the need and duty of the community to make possible attainment for its citizens the necessities of a full and efficient life "[2]

Experience has shown in the Western countries, especially in America, that long term comprehensive planning for growing cities is possible, practical and successful These city planning organizations are not meant for spending millions, but for finding ways and means for efficiently utilizing the money that will be spent (by public, Government or privately) to build up the city, and to save the millions which would be otherwise spent to correct the faulty layouts In other words, the city planning organizations are the technical bodies competent to decide and advise on the suitability of sites and layouts to the best advantage of the growing communities

City planning activities are guided by the three influences economic, functional and esthetic This applies to a new city as well as to an old city which may need replanning It is interesting to observe that while the medieval city planning was restricted to the esthetic (rather, decorative) aspects—in building cathedrals, monuments, palaces and a few civic centres,—the idea swang back to 'city practical' with the coming of the industrial age However, the modern trend is to compromise the two and get a balance While it is important to plan a city from practical point of view—in respect of street system, transport, safety, water supply, sewerage, housing and zoning, etc , it is no less important to make the city beautiful and provide the community with pleasing environment in architectural and landscape sights In fact, beauty is a necessary adjunct to good living It is interesting to mention in this connection that the people of the city of Zurich in Switzerland have voted to demolish an existing bridge across a stream passing through the city, only because it is not pleasing to the eye, and does not match with the architectural structures around it They have therefore decided to finance for a new bridge in its place.

Historical

"The city is as old as civilization itself" And many of the ancient cities in Egypt, India, Assyria, Greece and Rome were laid on definite plans in respect of streets, housing and grouping of types of housings The remains of the ancient small city of Kahun in Egypt, which flourished between 3000 2500 B C is perhaps the example of the oldest planned city The city of Babylon was built on either banks of the river Euphrates, with definite rectangular blocks pattern It not only had the magnificent road systems, but also beautiful forests, gardens and pleasure grounds including the celebrated Hanging Gardens The magnificence of Babylon attained its climax in 6th century B C

Many of the ancient cities were fortified with walls and water trenches all around, and architectural grandeures and ornamentations were freely introduced The city of Nineveh (3000 to 606 B C) is an example of this The 'city' of Jerusalem calls for special attention regarding the choice of site and beautiful layout on the hill slopes The city of Mohenjo Daro (3000 2000 B C) in the Indus Valley is another example of city planning, architecture and engineering works

The Greek city of Priene (3rd Century B C) in Asia Minor on the north shore of Latmic Gulf presents some features of an ancient city of 400 homes of 4000 people It was apparently planned with great care Its main thoroughfares ran along the contours of the hill, and the narrow lanes led up hill The blocks were 115 ft by 150 ft, while the broader streets were 23 ft and narrower ones 10 ft wide The entrances to the houses were on the side streets while the main streets had facing them walls almost entirely blank, thereby securing privacy for the dwellers One of the most interesting features of Priene was its spacious market place with its public buildings

Many of the ancient Greek and Roman cities are characterised by their semicircle of great edifices

The characteristics in city planning in the renaissance period may be found, starting in Italy and influencing France and England, in widening and straightening roads, building massive cathedrals and royal palaces, and trying to introduce regularity and symmetry in the layouts and structures More open space, gardens, statues, decorations and artificial fountains were introduced in order to beautify the cities The medieval city planning was more the outcome of the visions of artists and architects than that of engineers, until the industrial civilization came into being

Industry, commerce, and improved methods of transportation have all played an important part in the growth of cities in the last hundred years The resulting congestion that has been experienced everywhere has completely changed the outlook and philosophy of modern city planning. "One of the first and most striking modern efforts at such improvements was the immense programme in Paris in 1853 by Baron Haussmann under Nepoleon III Haussmann's scheme included a number of large projects, boulevard connections of importance and of great extent, roads converging at important points and public buildings located in full view down the streets, and the development of plazas and parks The expenditure of 50,000,000 livers for these improvements helped greatly to make Paris one of the most beautiful cities in the world

"While France was directed rather strongly by the esthetic view point, Germany was probably more concerned with matters of efficiency and economy Among the leaders of city planning in the Germany of the last century are Reinhard Baumeister, a pioneer of the science, Camillo Sitte, a formulator of its esthetic principles and Joseph Stuebben, a practical city builder "[3]

City Planning Movement in the United States of America

The history of city planning movement in America is about a century old, but it has taken more definite shape within the last forty or fifty years The establishment of the first village improvement association at Stockbridge, Mass, in 1853 is a landmark in the early history of American city planning movement In course of 30 years, a hundred of such associations were formed in the country The creation of New York Central Park in 1857 exerted a major influence in this direction The first efforts in 1857 of a Commission to investigate into the slum conditions in New York City and Brooklyn marked the beginning of a great housing betterment

A large number of city planning commissions—now numbering about a thousand—have grown, which publish their fact findings and accomplishments in planning Programs of procedure have been evolved, more power acquired, and more influence—so that the city planning commissions have gradually taken an important and recognized position in the communities

One of the earliest of such organizations is the American Civic Association formed in 1904 The National Conference on City Planning was organized in 1910, and a more technical organization of the City Planning Institute was formed in 1917 The U S Department of Commerce in Washington D C has also been doing good work in the field of city planning Other active and influential organizations are the National Housing Association (1911), the American Federation of Arts (1909), the National Commission of Fine Arts (1913), and the Federated Societies on Planning and Parks (1926)

There are other organizations who are contributing a great deal in the field of city planning Such bodies are —groups of architects, landscape architects, municipal engineers, civil engineers, recreational specialists, commercial and real estate men, and automobile manufacturers and dealers.

One of the most interesting drive is the 'City Beautiful' movement in America, which started comparatively recently Under this movement the esthetic aspect of city planning are stressed Rewards and recognition are given to the city authorities for their efforts in the direction City beautiful movement has been a timely check against the growing emphasis to 'city practical' of this industrial age which has a strong tendency towards giving a city the look of gross commercialism

The Nature of Urban Dwellings

It is true that houses are built in walls, floors and roofs If this was the only consideration, building a house would be as simple as to construct a stable for horses But neither human life nor his requirement is as simple as that of a horse

But, what has been the structure and layout of the houses in our cities? They are no better than stables and garages As a matter of fact many people have actually built their homes (?) in stables and garages in our large cities today The defect in designs is in acute state in urban areas where most of the people live in rented houses, flats and apartments provided by the landlords Serge Chermayeff, an American architect and a Fellow of the Royal Institute of British Architects, observes "By far the largest percentage of multiple dwellings, whether vertical apartments or horizontal row houses, were not designed as living space, but as an investment for the landlord They have been unattractive, have lacked amenities and have forced dull uniformity and anonymity on the occupant"

Yet, the lack of general ideas in house planning and architecture, even for the owners own house, is appalling Whether for renting or for living, no one seems to have paid any thought as how to design a house for comfortable living "The examination of most housing problems," continuos Chermayeff, "reveals the prevailing confusion as to what living space is The confusion exists not only in the mind of the public but in the minds of those who supply the housing, the authorities, the real estate agents or, all too frequently and less pardonably, the designers"

Ownership of house is an important and interesting study in large cities There is always a general trend of decline in private ownership of homes, and greater and greater number of people live in rented houses and apartments By 1920, private ownership in New York City went down to 12 7 per cent which means that 87 3 per cent of the city population lived in rented houses[4] The overall tenancy in the American cities was 61 5 per cent in 1940[1]

Under such condition, the landlords have a big responsibility which they usually shirk and thereby lower the standard of housing to a great degree.

While most of the housing will remain in the hands of private enterprise, it can and should take advantage of the advice from the city planning authorities However, in this age of industrialization in which Federal, Provincial and Local Governments are increasingly taking active interest in the matters of housing and zoning, it is but natural that these and other public agencies will be coming forward to help in the building or remodelling of cities In the United States, the Federal and State agencies are active in overall planning of cities, and giving financial aid for building low-rent and no rent houses for certain sections of the community India, at the present moment, is taking great interest in this matter and is apparently ready to render financial assistance as far as possible But unfortunately the authorities have not formulated any city planning organization to handle the problem scientifically

Types of Organization

There can be three types of City Planning Organizations (1) Federal or State, (2) Regional and (3) Local Of these three, the function of a local city planning body is more readily understood, being as one which is active on a particular site or city On the other hand, "The need for Regional Planning", says Hubbard, "resulted when it became evident that the interests of the community were not always contained within one political boundary" In fact, regional city planning is essential for large metropolitan areas The best example of it is to be found in the Chicago Regional Planning Association which was formed in 1924 This regional planning Association was formed for the purpose of guiding and developing the region of Chicago within 50 miles of the city limits The central organization of the C R P A is maintained with a staff consisting of one President, 5 Vice-Presidents, 1 Secretary and 1 Treasurer These members are elected every year In addition, there are 30 Directors, each representing some section of the region The term of one-third of them (i e of ten Directors) expires every year[5] The other notable one in America is the Regional Planning Federation of the Philadelphia Tri-State District (established 1923) which plans for eleven counties of the three States—Pennsylvania, New Jersey and Delaware that are grouped around the Philadelphia Camden metropolitan centre[6] Thus planning body has its jurisdiction over 4,500 square miles which supports a population of more than 3,500,000

The Federal organization is important for coordinating the planning works throughout the country Its chief function is to be of a fact-finding nature, and it will supply the basic data to local and regional bodies The State organization will also check duplication of work

Most important function of the Federal Organization is to form a stable nucleus and give recognition and impetus to such an important socio-technical movement in the country.

PLANNING FOR AN OLD CITY

An old city needs replanning for two chief reasons First, to correct old mistakes, and to remove the evils brought forth by them Secondly, to amend obsolete laws and enact new ones and enforce them according to the current need of the community

The biggest problem of an old industrial city is the question of its *slum clearance* The slum grows through lack of plans and policies on the parts of the city authorities and the industrial employers, and for the general lack of co ordination between them As a result, the slum grows till it gets beyond tolerable limit when a drastic measure becomes necessary at a tremendous cost The city of Calcutta, for example, has reached this state It is roughly estimated that about 27 per cent of the population (at 3 5 million) live in slum areas in Calcutta, and is still growing particularly due to the influx of refugees after the partition of India

However, a thorough survey of the problem is essential before any measure can be planned for This slum survey should aim at correct estimation of the number of slum dwellers, family sizes, income brackets, area covered and physical condition of housing, sanitation, etc

It should be remembered that slum is an unavoidable problem in this industrial age, unless special and constant attention is given to avoid it It is yet a matter for special consideration in a country like ours where the average income of the wage earners is apallingly low Although we may say that we have some thirty per cent of slum dwellers in the city of Calcutta, the figure would increase above fifty per cent judging from any decent standard of living as to be found in the Western countries This includes a large portion of the so-called middle class In other words, our slum problem is only a part of the general housing problem

In fact, "the eradication of slum and their replacement by decent housing is justified at almost any cost because such efforts tend to strengthen the fibre of the nation "

The *housing* plan for an existing city includes several items Primarily, it needs a strong city authority to enforce certain codes of building standards regarding their construction, maintenance and provisions for amenities While most of the designs of the existing houses cannot be altered, good deal of modern utility fittings may be easily included to the advantage of the occupant Such fittings may include adequate electrical wiring, heating and cooking lines (gas and electric) with separate meters, sanitary fittings, extra water taps and wash basins, water pumps and overhead reservoirs, tube wells and so on Further, if a strong safety and sanitation code is enforced, quite a lot of the delapidated houses will be found unfit for human occupation, and they should be demolished forthwith

New houses, on the other hand, should be designed with pre thought on the requirements of a good home, and proper architectural consideration should be given

An old and growing city usually suffers from *Traffic congestion*, and unless a systematic traffic study is made, it leads to great hazards in accidents, loss of time and money In the city of New York the loss due to traffic congestion is estimated at 1,000,000 dollars a day, and the loss due to traffic accident in Chicago at 120,000,000 dollars in one year The annual economic loss through traffic accident throughout America is over 600,000,000 dollars

The study of traffic movement is essential for traffic planning—in opening new routes for public vehicular services, for diverting and dividing different types of traffic and avoiding bottlenecks Traffic study is also necessary for the development of suburban areas and satellite towns around a metropolitan area

Any sum appropriate for traffic study is well paid for saving the loss of money, time and life

The question of *water supply* in a city is one of the major items which should receive primary consideration The standard of cleanliness and sanitation of a city can be judged by the amount of water that the people of the city is supplied with Cities of Bombay and Calcutta have the biggest water supply systems in India, but even in the pre war days they hardly provided 50 gallons per capita per day (g c d) It may be guessed that now, when the population of these cities have grown between two and three times as much, without much improvement in water supply, the present consumption will hardly hit the mark of 20 g c d of filtered water The average city supply in a civilized country is around 100 g c d or roughly 5 times the present per capita supply of Calcutta or Bombay The city of New York gets about 137 g c d , Chicago 260 g c d ,[7] and even the cities of California, a semi-desert State, receive over 130 g c d

There is considerable need and scope for improving and developing *parks and open space* for play grounds and recreational purposes Twelve percent of land area is about the minimum limit of open space within the city limits Where this minimum amount has not been developed, every effort should be made by the city authority to acquire lands for developing parks, play grounds and swimming pools It is also necessary to develop equal amount or more of the marginal lands for similar purposes Advantage should be taken of natural settings, if fortunately available,—such as water fronts, hills and lakes, which can be developed into beautiful recreational areas

PLANNING FOR A NEW CITY

In certain respects it is more satisfactory to plan for a new city than to improve an old one, as its results are more assured,

India needs many more cities to build across the length and breadth of the country for uniformly distributing the population, and for national integration We would need some 1,500 new cities of average 100,000 persons in order to accommodate half of our population

The first move in this direction would be the formulation of a National City Planning Commission, and development of local and regional bodies, about which a tentative plan has been given here in later pages

Selection of site is the first step to build a new town The selection is guided by several factors of which physical and economic factors are the most predominating ones A complete survey of topography, water resources (surface and under ground), drainage lines, economic resources and commercial possibilities, etc are necessary in order to determine the suitability of the site Its present connection with the communication arteries of the country, availability of building materials and other facilities are also to be considered

While planning for a new city, sufficient foresight is necessary to see the future growth of the city and provide it with necessary flexibility for its future expansion When the city is growing, constant attention should be given to population prediction, and extend the plan ahead of time

Public utilities should be given the first consideration in building a new city This includes primarily water supply, sewerage, electricity, gas, transportation and communication

Housing should be built on a sound building code, and *zoning* is necessary to maintain an order and decent appearance of the city Most prevalent system is to have four zonings Industrial, Commercial, Apartment and Residential with their respective building codes

A well laid out city should be better intelligible and less confusing to any stranger, and the *street system* and *house numbering* should take some standardized form Although much could be said about radial vs rectangular street systems, the latter is the simpler and more commonly used Rectangular block system with streets numbered, rather than named, is the easiest one to follow Under such system, Avenues and Streets run crosswise, numbered as 1st, 2nd, 3rd, , and each house is numbered after the number of block from the main co ordinates of the roads Thus a house bearing the number 1105 East 4th Street will immediately tell you that it is the fifth house on East 4th Street, eleven blocks away from the main Avenue Thus every house can be easily located

These rectangular blocks (*a block* is the property lots enclosed within four streets surrounding it) may be of any size, but conveniently, between 300 and 400 ft on the long side A block consists of two rows of properties divided by a central alley 15-20ft wide at the back yards If the depth of the lots are 125 ft then the total depth of the block comes to about 270 ft

Under such a rectangular system some 35-40 percent of the gross area is devoted to streets, which is usually a little higher than that in a radial (or circular) system of streets

For decent living, the density should not exceed 15 families per gross acre In the United States, 12 families (of average size of 5 persons) is recommended, while above 30 families per acre is considered dangerous The Industrial Housing Sub Committee of the Government of India recommended[8] a density of 20 houses (=100 persons) per acre for the industrial workers and this is fairly reasonable

It is difficult to overemphasize the need of *school building planning* Our school buildings in large cities are horrible in as much as they are completely derogatory to children's physical and mental health Lack of proper lighting, ventilation, play grounds and recreational facilities make the school a kind of prison for which no child can have love for his or her school

School buildings need a special kind of architecture and special kind of layouts

It will be intersting to note how much attention is given in school building programme in America The minimum requirements, however, varies with the State laws Generally speaking, large Elementary School should have 5 or more acres of land, 20 acres for high schools, with play ground at 100 sq ft per pupil All schools should have a flag staff at least 40 ft high Floor area is to be provided at 12-20 sq ft per pupil, air space 200 225 cu ft, and toilet fixtures at one per 25 30 pupils

Interesting studies were made through parents' opinions to decide on what could be the maximum travel distance for school children The figures obtained are as follows Half mile for elementary school children, one mile for junior high school children, and 2 miles for senior high school children[9]

Before selecting a site for a school, several factors are to be considered Strayer and Engelhardt formulated a 'score card' for selection of a school building site based on the consideration of these items According to Strayer and Engelhardt, Location and Assembly carries 250 points, Size 300 points, Topography 250 points, and Utility and Cost 200 points, making a total score of 1000 The site, out of a few alternatives, which scores highest should be selected

City Planning and Refugee Problem

The present problem of the refugee rehabilitation is not a seperate problem in itself, but is a part of the general rehabilitation problem of our country The opening of separate colonies for the refugees will hardly hit the solution, on the contrary, they are likely to develop into colossal slums

The programme of resettlement of these unfortunate displaced persons should come under the general city planning activities, and the refugees should be

accommodated in every old and new cities, properly planned, where they can find economic opportunities and healthy social environment There are more sociological considerations in this matter, than just to dump them in huts and buildings made for them They are to be rehabilitated in order to 'strengthen the fibre of the nation', but so long as their case are treated as an isolated problem, nothing will be accomplished

Very correctly our Governments (Central and Provincial) have thought out the methods of distributing lands and buildings to the refugees and liquidating the loan in course of time Such programme can be easily extended to all the enterprising citizens to develop the unproductive and undeveloped regions of our vast country under a sound city planning movement It may be noted in this connection that the Government of the United States formulated the Homestead Law in 1862 awarding free lands to encourage the people to settle on the Western half of America in order to relieve the East of its population pressure Under this Act, free land were provided to people who would undertake to develop and settle in the West, the Government providing them with some of the primary amenities of life In order to meet the primary requirements, the U S Government established in 1902 the Bureau of Reclamation and entrusted it with harnessing water resources in the arid west and producing electric power

Our Government can also take the lesson and plan to integrate our nation through such nation building projects

City Planning Organizations for India

As explained in the previous sections, India needs formation of a Central City Planning Organization, together with local and regional ones Some of the principal features and functions of these organizations are suggested below

National City Planning Commission is to be the parent organization sponsored by the Government of India to act as the nucleus of the city planning activities throughout the country The chief function of the Commission will be to collect and disseminate information pertaining to city planning problems

Although no attempt has been made so far to collect and co ordinate the data, valuable information lie scattered in the hands of the respective municipal and other bodies of our existing towns It is regrettable to mention that many information of national interest are sacrosanct to public who have no access to these data The author has had very unfortunate experience in this country in his attempts to collect such data of public interest from our Government offices and other agencies, while he found it exteremely easy to collect such information abroad, especially in America No planning, whether national, corporation or private, can be possible unless there is free exchange and dissemination of information It is ridiculous that our Governments could publish many technical reports on matters of public interest and label them as 'confidential' or 'for official use only', thereby barring the citizens to take interest in their own affairs

The Planning Commission, in the first instance, can contact the relevant authorities (municipalities, corporations, public utilities, etc) of our existing cities and compile a set of valuable information Later on, it can proceed to make field studies, or suggest the respective bodies with needful surveys for their own benefit and for the benefit of the public

The City Planning Commission is to be constituted of technical experts in various fields, such as, engineers, architects, landscape architects, geologists, geographers, economists, population experts, statisticians, scientists, not excluding lawyers, industrialists, and experts in other professional fields with experience in planning It is also essential that most of the members should be full time workers

The activities of the Commission may be divided into several sections, such as for Population studies, Housing and Zoning Regulation, Public Utilities, Economic Studies, Social Studies, School Planning, Slum Clearance Programme, Parks and Recreational Planning, Refugee Rehabilitation, New Town Site Surveying, and a few more as may be necessary

Regional Planning Committees The need of creation of Regional Planning Committees are already felt in several metropolitan areas in India, such as Calcutta, Bombay, Madras, Kanpur and other places The suburban areas of Calcutta, for instance, in its (about) 25 miles of radius is so vitally interlinked in its industrial, commercial and residential interests that the need of proper planning of this entire area of about 2,000 square miles appears to be extremely vital The satellite towns are being allowed to grow haphazardly with unplanned street system and housing, inadequate transport and communation facilities, and meagre public utilities to function Most of the activities of these Regional Planning Committees would be in the direction of Housing Improvement, Slum Clearance, Expansion of Public Utilities, and establishment of standards of amenities, and co-ordination between the different parts of the entire area At the present moment the Committee may also be entrusted with the placement of the refugees to the predetermined and optimum capacity

Local Planning Boards All the existing towns, and those to build, are to be placed under their respective city planning bodies in order to develop them scientifically Like the National and Regional bodies these local planning boards will collect relevant information and their investigations should be more thorough and intensive on their local sites under development The local planning boards, like the regional committees, will also plan intensively within their respective jurisdictions

All these three types of organizations will work in co-operation, exchange their data and views, and will co-operate with the public.

Conclusion

The city planning movement, as we need it today, is a matter of great concern for our country. Considering the present state of the situation we find that there is the pressing need of remodelling our cities to bring them up to the modern standard. A large proportion of the effort is also to be directed in finding the possibilities of opening new cities.

India's economy is lopsided. Our industry is poorer than our poor agriculture. Our leaders are determined to get a proper balance by developing our national industries. But industry has an entirely different reaction on the society than the agricultural economy would give us.

Industry evolves the urban structure whose functional activities are different from the rural one to which our large agricultural communities were so long accustomed. But a great change is coming: industrial economy is gradually taking the place of agricultural economy of our country. With it will come the complexities which, when properly administered, will give us more opportunities and fuller life.

Cities are the outcome of industrial economy. We need both of them, and they are inseparable. We shall have both, or none. But if we neglect, as we are doing, to build our cities on definite plans, we are apt to get into a mess in course of time. Our large industrial cities are already in it, and it is high time that we pay attention to them, and to the cities we are going to build in future.

It is important to see that our two large cities, Calcutta and Bombay, commands the highest concentration of population, and more and more people from all quarters of the country are being drawn into them. This is because these two cities provide the maximum economic scope consistent with the present concept of industrial economy. It should not also be overlooked that these two cities together produce half of the total electricity produced in whole of India, which shows why other quarters of India are lacking in their developments. Development of electricity in India has drawn attention of our national planners, and many hydro-electric schemes are under consideration or in the making. River valley development has also been started. Our future city planners can take advantage of these sites. Let us also think of city planning along with these industrial developments, and co-ordinate human happiness in good living in the complexities of the industrial age.

India is a vast country where most of the lands are yet undeveloped and virgin. There are stretches of land thousands of square miles in area where touch of modern civilization has not been experienced and where primary amenities are hardly available. But let us not expect all these facilities and amenities to exist in the backwoods by some act of miracle. These are to be developed by man, and man has always developed them. Such development needs planning. The author has no hesitation to say that every inch of Indian soil can be made beautiful and habitable through proper planning and co-operative work of the individuals and the Governments.

City building is to be our biggest national rehabilitation programme for the even placement of our population of all quarters of the country. But foolishly we have made it a provincial issue. We have got to get rid of the legacy left by the British rule and adopt broad national outlook for our national integration. Unless the main land of India is thoroughly planned for balancing in the population distribution, the nation cannot be strong. India has enough land, in fact, more land is available per capita to Indian people than that to many other progressive nations including the British. India need not look forward, in the false name of 'population pressure,' to colonizing desert lands, marsh lands and islands before planning on her own vast main land. The population balancing on India's main land is not only possible through national city planning activities but is absolutely essential for her economic and social rehabilitation and for her national consolidation.*

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* The auther takes great pleasure in thanking Mr. R. L. Downing, Professor of City Planning at the University of Colorado, U.S.A., for his inspiring discussions and guidance in the study of the subject.

RECENT ADVANCES IN THE KNOWLEDGE OF CELLULOSE PART 1 - GENERAL REVIEW

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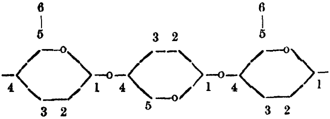
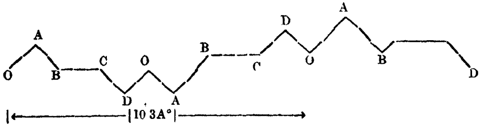
CHEMICAL STRUCTURE

CELLULOSE has a chemical formula $(C_6H_{10}O_5)_n$, with the usual meaning attached to C, H and O and with the value of n varying from a figure of two digits up to four digits, according to the source from which the material is obtained A sample of cellulose is known today to consist of a long chain condensation polymer of glucopyranose residues joined by 1 4 linkages, the length of the chain not being uniform but varying from that composed of a few glucopyranose residues to one of thousands of such residues To put an explanatory note, the repeat pattern of a simple substance or chemical group is a polymer and the formation of such by elimination of a molecule of water, a condensation polymer, the ring configuration of glucose is glucopyranose and according to the position of OH in the ring it is either α or β , 1 4 linkage is indicative of the way in which one glucose unit is connected with another in the pattern, the numbers signifying the position of carbon atoms , and glucopyranose residue means what is left in glucose after the elimination of water To illustrate diagrammatically the configuration of a chain of cellulose is as follows



In a three dimensional strainless molecular model constructed by using correct atomic parameters, the pyranose rings alternate in respect to the side that is uppermost Looking from the side, the chain appears as follows



The unit ABCD represents a β glucopyranose residue and O is the oxygen atom The identity period 10 3A calculated from atomic parameters checks well with the value found from X ray diffraction diagram Since this arrangement in a molecular model permits some rotation around the glucosidic bond, the possibility of a chain structure with an identity period different from that due to cellulose cannot be ruled out As a matter of fact, the identity period 8 7A for alginic acid fibre fits in with this concept of "armchair" or trans-form of pyranose ring having a freedom of rotation round the glucosidic bond

REACTIVITY OF CELLULOSE

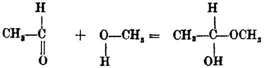
A cellulose chain has some characteristic features due to the chemical groups attached to the pyranose rings There are two secondary OH groups bound with the carbon atoms 2 and 3, and a primary OH group with the carbon atom 6 If cellulose is subjected to acetylation (treatment with acetic anhydride and acetic acid under homogeneous condition) such as obtained by preswelling in H_3PO_4 or calcium thiocyanate (so that no impediment to acetylation is present on account of crystallinity or otherwise), the primary OH groups at 6 are acetylated twice as rapidly as the secondary OH groups at 2 and 3, on the other hand in the process of xanthation (treatment with about 18% NaOH solution and subsequent treatment with CS_2) the xanthate group (CS_2 group) is preferentially bound with the secondary OH group in 2-position It seems in this case that primary OH groups are most strongly bonded in the structure and so least reactive to a third component, whereas secondary OH groups are least bonded and, therefore, can react more freely It is only in a homogeneous system when the bondings of C_6 hydroxyls are broken that the primary hydroxyls are preferentially attacked The strong bonding between the primary OH groups in cellulose is assumed to be due to the formation of "hydrogen bond," i e , a type of bond formed between two molecules by means of a hydrogen bridge giving the appearance of a valence of two to the hydrogen atom Many interesting phenomena in cellulose are bound up with the inactivation of OH groups, perhaps in 2 and/or 3 positions.

If two OH groups are separated by 4.0A° (which is the normal distance of Van der Waals forces) they retain their normal reactivity. However, if they are separated by 2.8A° (corresponding to H-bonding) they will lose some of their reactivity, finally if they are separated by 1.5A° they react with each other to form an ether (R O R) which is an irreversible cross links. Between these three extreme cases there may be a whole series of intermediate cases of bonding and reactivity. The decrease in reactivity of cellulose (as shown by, say, less hygroscopicity, less acetyl content after acetylation) on drying is possibly due to these mechanisms, the hydroxyl inactivation depending upon the manner in which the water molecules are taken out of cellulose in the process of drying.

As for example, use of heat tends to violent vibration of chain molecules as a result of which they come into each other's sphere of action for formation of hydrogen bonds. Therefore the best means of elimination of water held by hydrogen bonds keeping the structure open is to use successively larger molecules like alcohol, ether, cyclo hexane for replacing water. These larger molecules are of course difficult to remove but even if some of them remain they do not interfere with ordinary reaction like acetylation.

Special Structure Features

Looking at a chain molecule of cellulose and remembering the manner in which the ring form of sugar is derived, it will be noticed that in a complete chain both terminal glucose residues are distinguished from those in the body of the chain, one by the presence of a reducing hemi-acetal and the other by the presence of an extra hydroxyl group. The term hemi acetal means the structure produced by opening up of the double bond of an aldehyde



aldehyde *alcohol* *hemi acetal*

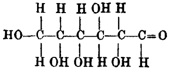
Similarly the ring form of sugar is a hemi-acetal as illustrated by the following diagram –

The experimental evidence in support of the presence of a hemi-acetal is not very convincing, although numerous workers have attempted to evaluate the chain length of cellulose on this idea. However, the presence of an extra hydroxyl group at one end of cellulose chain has been proved beyond doubt from methylation experiments.

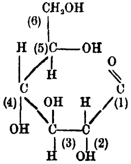
There is another peculiar feature of cellulose. The study of the degradation of cellulose reveals that here in contrast to that in polyesters or polyamides, one has to reckon with some foreign or odd bonds along the chain, over and above those due to 1 4 glucosidic linkages. The kinetics of degradation of long chain molecules with identical bonds along the chain have been worked out by a number of investigators and in cases of molecules of polyesters and polyamides theoretical formulae have been fairly well confirmed by experimental results. Both degradation and rate of hydrolysis studies support the view that there are weak spots distributed along the chain, and the frequency of occurrence of these spots is about 1 in 500 glucose residues for ordinary cellulose. The structural role played by these weak spots has been emphasized in a recent communication which suggests a new structural formula for cellulose and ascribes these weak spots to simple sugars, such as, glucose, cellobiose, cellotriose etc occurring in hydrated open chain forms and holding the long chain molecules together by means of hemi-acetal linkages between the hydrated aldehyde groups and any of the alcoholic groups of the glucose units in the main chains.

Thermodynamic Properties

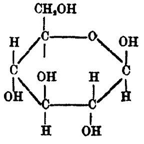
Thermodynamics deals with the external effects of external causes and its results do not depend on preconceived ideas about molecules and chain structures. As a matter of fact, the conclusions derived from thermodynamics would be valid, even if there were no such things as structures and molecules. Now on account of its chain structure, associative groups like OH and high molecular weight cellulose possesses certain special thermodynamic properties regarding solubility and viscosity and osmotic pressure of solutions. For example, while in a dilute solution of spherical particles the dissolved particles are free, being almost com-



d glucose



open chain



closed chain

pletely saturated with solvent, so that there is no significant interaction between the particles themselves, in even highly dilute solutions of cellulose the molecules are not free because of the associative groups (OH) and the resultant high interaction between solute and solute as well as between solute and solvent It is possible through the application of thermodynamics to deduce for a solution a relation between the activity (fugacity or escaping tendency), heat of mixing (relative attraction energies of like and unlike molecules in the solution), and entropy (randomness) of mixing of its component or components In the case of several chain polymers the quantitative relation thermodynamically deduced, after taking into account the deviation from ideal conditions of zero heat of mixing, uniform size and shape of molecules and perfect randomness of mixing, has been found to agree with the experimental results The physical states of a chain polymer as to its flexibility, mode of packing and mutual attractive forces have a pronounced influence upon its solubility Thus polyvinyl alcohol having the same ratio of OH groups to carbon atoms as cellulose, is soluble in water The explanation is that the polyvinyl alcohol chains are very flexible to allow penetration of solvents which results in the greater entropy change on dilution The water solubility of starch is traceable to the highly branched nature of its chief constituent amylopectin which makes the packing of the chains rather loose when compared with cellulose, the increase in the solubility of cellulose derivative with the increase in the substitution of OH groups to a certain point, indicates that the mutual attractive forces between the chains tend to reduce solubility

The solutions of cellulose and cellulose derivatives in various organic and inorganic solvents have been the subjects of numerous investigations All experimental evidences to date support the view that cellulose is molecularly dispersed in such solutions, each molecule being only occasionally associated with its neighbours, and any such association, if at all formed, being soon broken by thermal agitation The molecular size of cellulose may be determined from measurements on its solutions such as, viscosity, osmotic pressure, sedimentation in ultra centrifuge and light scattering The term viscosity means resistance to flow which is the property that regulates motion of adjacent portion of the liquid and can be considered as a type of internal friction The viscosity of a gas can be explained from the point of kinetic theory assuming momentum transfer as a result of collision between gaseous molecules But this concept of momentum transfer cannot be applied with the same success in the case of liquid viscosity. A theory has however been recently proposed to explain the viscosity of simple liquids in which assumptions have been made that liquid contains holes somewhat smaller than the molecular size and that the system may be treated, as consisting of molecules in a solid state, with organized structure interrupted by the molecules in the neighbourhood of the holes which are in the gaseous state. The molecules in the liquid are assumed to jump into the holes, at random in all directions and the effect of shearing stress is to reduce the activation energy necessary for molecules to jump from one point to an adjacent hole, if the jump takes place in the directions of the force and to increase the activation energy, if the jump is in the reverse directions

In the case of suspensions of colloidal particles increase in viscosity over that of the continuous phase originates by a mechanism different from that which applies in the case of simple solutions For rigid spherical particles the specific viscosity, η_{sp}

$$\left(i\,e\,,\ \frac{\eta - \eta_0}{\eta_0},\ \text{where } \eta = \text{solution viscosity},\quad \eta_0 = \text{solvent viscosity}\right)$$

varies linearly with volume concentration and is independent of the size of the particles For non spherical particles various relationships in terms of axial ratio of the particles, volume concentration and specific viscosity have been proposed from time to time The relation between concentration and viscosity of a dilute polymer solution can be expressed as a simple power series

$$\eta_{sp} = \alpha_0 + \alpha_1 c + \alpha_2 c^2 + \alpha_3 c^3 +$$

in which α_0 must necessarily be equal to zero since the specific viscosity of pure solvent is zero Then

$$\eta_{sp} = \alpha_1 c + \alpha_2 c^2 + \alpha_3 c^3 +$$

Neglecting the higher terms than the quadratic and dividing by c

$$\eta_{sp}/c = \alpha_1 + \alpha_2 c$$

If η_{sp}/c is plotted against c, one gets a straight line having an intercept, α_1 along the X axis which is called the intrinsic viscosity, $[\eta]$ The relation between intrinsic viscosity and molecular weight can be generally written as

$$[\eta] = KM^a \text{ where } K = \text{constant},\quad M = \text{molecular weight}$$

The value of the exponential factor a depends on the form or shape of the molecule and varies between 0 and 2, according as the molecule is highly coiled into a spherical form, randomly curled or rigidly extended in the form of a rod For cellulose acetate the value has been found to be 0 78

In view of the rather involved relationship between intrinsic viscosity and molecular weight of a chain molecule as indicated above, it is not possible to determine the molecular weight from measurements of viscosity alone The method, if at all to be used, requires determination of molecular weight—intrinsic viscosity curve for each polymer-solvent system, which then offers a convenient method of finding the molecular weight of new samples of the same polymer from measurements of the intrinsic viscosity of its solution in the same solvent.

Molecular Weight

Strictly speaking, molecular weight is the property of a pure homogeneous substance and since cellulose like most other high polymer substances is not such a material, its molecules in a given weight varying in lengths, (so that there is a frequency distribution of chain lengths) one can only speak of an average molecular weight of cellulose and such like polymer substances The value of the average depends on what type of average is considered or obtained by the particular experimental method employed There are four important averages (1) Number average $\bar{M}_n$, (2) Weight average, $\bar{M}_w$, (3) Z average $\bar{M}_z$, and (4) Viscosity average $\bar{M}_\eta$, expressed mathematically,

$$\bar{M}_n = \frac{\Sigma M_i n_i}{\Sigma n_i}$$

$$\bar{M}_w = \frac{\Sigma M_i x_i}{\Sigma x_i}$$

$$\bar{M}_z = \frac{\Sigma M_i^2 x_i}{\Sigma M_i x_i}$$

$$\bar{M}_\eta = [\,\Sigma M_i^a x_i\,]^{1/a}$$

where n_i, x_i and M_i are the numerical proportion, weight fraction and molecular weight of fractionated material of narrow molecular weight range The determination of molecular weight in general, therefore, involves separation of the material into various fractions according to chain lengths, by first dissolving it in a good solvent and then precipitating out with a non solvent The molecular weight of each fraction is then determined by any of the methods such as end group estimation, cryoscopic and ebulloscopic determinations, osmotic pressure, light scattering, viscosity and ultra centrifuge The end group, cryoscopic and ebulloscopic methods are not of much use for determining the molecular weights of cellulose, since they are not reliable for materials having molecular weights more than a few thousands Regarding the principles involved in the other methods the following is a brief summary

(i) *Osmotic Pressure*—In a system consisting of a solution and a solvent, separated by a wall of semipermeable membrance which allows only solvent molecules to pass through, the energy will be imparted to the wall by the dissolved molecules and the pressure due to this is called the osmotic pressure The osmometers generally consist of two metal blocks into the faces of which shallow cylindrical grooves are cut The membrane is supported by the edges of these grooves and the osmotic pressure is usually read from the difference in height of the solvent and solution in two capillaries connected through channels to the grooves on the two sides of the membrane

The membranes are usually made of nitrocellulose or cellophane. Since the van't Hoff equation governing osmotic pressure, concentration of solution and molecular weight does not hold in the case of high polymer solutions and quantity P/c ($P=$ osmotic pressure, c = concentration) increases rapidly with concentration, a curve showing the relationship of P/c and c has to be drawn The intercept on the ordinate of this curve being inversely proportional to molecular weight, according to the equation, Intercept $= \frac{RT}{M}$, (where, R = gas constant, T = absolute temperature) affords a means of obtaining the molecular weight The deviation from van't Hoff's law has been explained by several authors in terms of a constant defined by the slope of the P/c vs c curve The value of this constant is assumed to depend upon a number of factors such as, heat of mixing, shape and flexibility of chain molecules, randomness of mixing and swelling of the molecules in solution

(ii) *Light Scattering*—This method is chiefly due to Debye and Doty When a beam of unpolarised light passes through a solution the total amount of scattered light is related to the molecular weight of the solute in such a way that measurement of intensity of the scattered light at 90° to the beam, may be used for determination of molecular weight The method involves measurements of turbidity, osmotic pressure and refractive index of solutions, and knowing the wave length of light used, the molecular weight can be evaluated from the relation

$$Hc/\tau = \frac{1}{M} + \frac{2B}{RT}c$$

where H = constant depending on wave length, refractive index and osmotic pressure, according to the relation

$$H = 32\,p^3\,\gamma^2\,\mu^2\;/\;3N_o\lambda^4$$

(where N_o = Avogadro's number, P = osmotic pressure, γ = increase of refractive index with solute concentration, μ = refractive index of pure solvent), τ = turbidity defined by,

$$I = I_o e^{-\tau l}$$

where I_o = intensity of incident beam, I = intensity of scattered light, l = length of the scattering medium, M = molecular weight, c = concentration, R = gas constant and T = absolute temperature Plotting Hc/τ vs c, a straight line is obtained and the intercept on the ordinate of the straight line gives $1/M$. Comparing the effects of molecular weight on osmotic pressure and turbidity, it can be seen that osmotic pressure is inversely proportional, whereas turbidity is directly proportional to molecular weight This indicates that osmotic pressure method is particularly useful for low molecular weight and light scattering method is more appropriate for high molecular weight. The use of the osmotic method for very low molecular

weight is however limited by the diffusion of the solute through the membrane and the use of the light scattering method for high molecular weight is complicated by dissymmetry of the scattering, which effect renders the application of this method less simple than it would seem to be at the beginning, but, on the other hand, contributes valuable information about the average shape of the dissolved molecules

(iii) *Ultracentrifuge*—The technique of ultracentrifuge largely due to Svedberg consists of centrifuging the polymer solution at an acceleration several thousand times gravity and measuring either (a) sedimentation rate or (b) sedimentation equilibrium

(a) Sedimentation rate This is determined by observing the rate of fall of a meniscus which separates the solution from pure solvent by means of either ultra-violet absorption or refractive index measurement The general equation for the fall of particles of mass m, specific volume V, under the action of a centrifugal field of angular velocity ω is,

$$u = m r \omega^2 \frac{1 - v\partial}{f}$$

where u = the constant velocity acquired by the particles under the mutual influence of buoyancy, friction and acceleration, r = distance of particles from the axis of rotation, ∂ = density of solvent or medium of suspension of the particles, f = co-efficient of friction of the particles

$$\text{or } \frac{u}{\omega^2 r} = s = m \frac{1 - V\partial}{f}$$

where s = sedimentation constant

Expressed in terms of molecular weight, M and co efficient of diffusion D,

$M = m N$ = molecular weight (N = Loschmidt number), $F = f N$ = molecular co efficient of friction

$$s = \frac{M}{N} \quad \frac{1 - V\partial}{F/N}$$

Now, $F D = R T$ (D = co-efficient of diffusion)

$$s = M \frac{1\ V\partial}{RT/D}$$

$$\text{or } M = \frac{SRT}{(1 - V\partial)D}$$

from which molecular weight can be determined regardless of the shape of the particles

(b) Sedimentation equilibrium A colloidal system may be centrifuged until the boundary between solution and pure solvent is no longer displaced, *i.e* when there is a balance between centrifugal force acting downward and diffusion acting upward For such a condition,

$$M = \frac{2RT \log (c/c_o)}{(1 - V\partial)\omega^2(x^2 - x_o^2)}$$

where c = concentration at the distance x from the centre of rotation, and c_o is the concentration at a reference point in the solution, x_o *cm* from the centre of rotation Using light absorption method of recording sedimentation equilibrium, one can plot log c vs x^2 to get a straight line the slope of which is

$$= \frac{M(1 - V\partial)\omega^2}{2RT} \log_{10} e$$

Knowing the values of the other constants molecular weight, M can therefore, be determined

Recent studies have shown that the molecular weight of native cellulose is somewhere between 1,200,000 and 1,500,000 For molecular weight determinations up to 1500 or 2000 the methods cryoscopic and ebulloscopic, which give the number average are reliable, for molecular weights of 20,000 and upwards there are a number of methods such as osmotic pressure giving the number average, light scattering which gives the weight average and ultracentrifuge which gives either weight average or Z average, depending upon the procedure The various averages are nearly equal when a well fractionated material is employed for the experiments Between the range 2000 and 20,000 the usual methods of molecular weight determinations do not seem to give very accurate values Recently there has been a claim from Paris by Guastalla, for the use of a new method of molecular weight determination which is reliable between the range 5000 and 30,000 This involves spreading polymer molecules in a Langmuir trough in such a way that they are independent of each other and exert a pressure against the walls (like a gas), which can be measured by constructing a very sensitive balance at the end of the trough.

Fibre Structure of Cellulose

Cellulose in ordinary available forms is not composed of isolated chain molecules It aggregates into fibres having crystalline and amorphous regions, the relative proportions of which can be determined by method of hydrolysis (due to Nickerson), density and X ray methods (due to Hermans) and isotope exchange method (Champetier) Mark has classified high polymers as rubbers, plastics and fibres on the basis of their crystallizing or aggregating tendency, the values of which he has calculated for a number of materials The index of crystallizing tendency is termed the molar cohesion per unit length, which is generally between 1000 and 2000 cals per mole for rubbers, between 2000 and 5000 cals per mole for plastics, and above 5000 cals per mole for fibres From the

point of view of mechanical properties, rubbers are materials with a low initial modulus of elasticity (10^6 to 10^7 dynes per sq cm) and a long range of extensibility and they are almost completely and instantaneously elastic, plastics are material with moderate initial elastic modulus (10^8 to 10^9 dynes per sq cm) and only a certain part of their deformation is reversible while another part represents a permanent set, fibres are materials with high elastic modulus (10^{10} to 10^{11} dynes per sq cm) and low range of extensibility, part of which is instantaneously reversible, part exhibits delayed elasticity and the rest represents permanent set The plastoelastic behaviours of rubbers have been theoretically worked out by a number of authors, *viz*, Kuhn, Tobolsky and Eyring Their theory does not however apply in the case of plastics and fibres

The Structure of Cellulose as revealed by X rays

The direct evidence for the fibrous structure of cellulose which is largely due to its crystallinity, as has already been stated, is provided by definite diffraction spots or rings in the X-ray diagram If cellulose were composed wholly of disorganised or partially organised cellulose chains, the X ray diffraction pattern would at best consist of one or two diffuse bands The diffraction pattern of a single cellulose fibre or a bundle of parallel fibres taken with the X ray beam striking at right angles to the firbo axis consists of disoriented arcs This indicates that a cellulose fibre is composed of crystalline aggregates which are oriented in such a way that a common crystallographic direction lies within a certain angle from the fibre axis The facts which may be deduced from a single X ray diffraction diagram for a given specimen of cellulose are, (1) crystallinity, (2) geometry of crystal system, (3) dimensions of unit cell, (4) size of crystals and (5) degree of orientation of crystals with respect to fibre axis Cellulose belongs to the monoclinic system having the unit cell parameters, $a=8\ 2$A, $b=10\ 3$A, $c=7\ 8$A and $\beta=84°$

Besides the native cellulose known as cellulose I having the unit cell structure as above, there are two other modifications of cellulose, cellulose II and cellulose IV, of which the former occurs in nature only in the marine alga Halicystis, but formed on mercerisation of cellulose I Cellulose IV is formed when strongly stretched mercerised cellulose is heated for about half an hour at 200°C The unit cell parameter of cellulose II and cellulose IV are

	a	b	c	β
cellulose II	8 1A	10 3A	9 1A	62°
cellulose IV	8 1A	10 3A	7 9A	90°

The crystallinities as measured by diffuseness, anomalous intensity distribution, and change of any particular spacing, of different samples of cellulose vary over a wide range But a wider variation is noticeable in the degrees of orientation of cellulose samples of different sources The orientation of the cellulose crystallites both as to type and degree of perfection can be determined from the intensity distribution along the arcs of the reflections in the fibre pattern Hermans, Kratky and Platzek have suggested a quantitative method of evaluating the X-ray diagrams of cellulose fibres The method consists of measuring the intensity distribution along the equatorial arcs 101, 10$\bar{1}$ (treated as one interference) and 002, and makes use of the expression,

$$f_x = 1 - \tfrac{3}{2}\left(\overline{\text{Sin}^2\alpha_0} + \overline{\text{Sin}^2\alpha_2}\right)$$

where f_x=orientation factor, α_0 and α_2 are the angular distances from the equator along the diffraction arcs $\left|\begin{matrix}101\\10\bar{1}\end{matrix}\right|$ and 002,

$$\overline{\text{Sin}^2\alpha_0} = \int_0^{\pi/2} F_0(\alpha_0)\,\text{Sin}^2\alpha_0\,\text{Cos}\,\alpha_0\,d\alpha_0 \Big/ \int_0^{\pi/2} F_0(\alpha_0)\,\text{Cos}\,\alpha_0\,d\alpha_0$$

and

$$\overline{\text{Sin}^2\alpha_2} = \int_0^{\pi/2} F_2(\alpha_2)\,\text{Sin}^2\alpha_2\,\text{Cos}\,\alpha_2\,d\alpha_2 \Big/ \int_0^{\pi/2} F_2(\alpha_2)\,\text{Cos}\,\alpha_2\,d\alpha_2$$

The numerical values of $\overline{\text{Sin}^2\alpha}$ can be derived from the intensity distribution curve, I=F(α) by the prodecure suggested by de Booys and Hermans, that is, by plotting the graphs I $\text{Sin}^2\alpha$ cos α and I cos α against α, graphically integrating the curves, and taking the ratio of integrals

In the colloidal range of dimensions, the smaller the particles and the fewer the diffracting parallel plains, the broader and more diffuse will be the diffraction maxima, which characterise a given crystalline structure This leads to methods of evaluation of crystallite sizes of cellulose fibre from measurements of the breadth of diffraction lines Several formulæ have been proposed from time to time by various authors but the assumptions on which the formulæ are based, are far from correct

As for instance, the crystallite sizes are not uniform, they are perhaps not free from lattice defects, and so on However, the size of the crystallite for ramie (cellulose fibre) determined by this method is, a=50A, b=500A and c=50A. Recently a more accurate method for determining the size of the crystallite has been suggested by Guinier and Hosemann, which consists of measurements of intensity of reflections due to scattering at small angles

Amorphous Cellulose

A microscopic study of the mechanism of cotton growth has revealed that there are daily growth rings in the cell walls of cotton The sharpness of these rings has been found to depend upon changes of temperature, quality of radiation and moisture in the surrounding atmosphere If cotton is grown in a laboratory under constant temperature, radiation and moisture, it does not show any growth rings and its X-ray diagram exhibits only one broad and diffuse halo with no sign of crystallinity This amorphous cellulose is supposed to have the interesting property of drawing like nylon, i e, become highly crystallised after drawing

The other interesting discovery is with regard to the behaviour of cellulose in ultra violet light Stillings and van Nostrand found that action of ultra violet on cellulose was not only the breakdown of glucosidic linkages, but the effect continued even after the samples were removed from the sources of ultra violet Of course, the latter reaction stopped when the samples were stored in atmosphere of nitrogen The start of the photochemical reaction by ultra-violet did not require, however, the presence of oxygen, since the action started even in the absence of oxygen. But for subsequent action oxygen was necessary It is possible that ultra-violet prepared the cellulose for subsequent attack by oxygen

This raises a question that cotton in the unopened boll remains undegraded but when the boll opens, after which harvesting is done, there is degradation of its average chain length There might of course be difference in the action of ultra violet on cotton on growing plant as compared with that after it is harvested A relevant analogy to this can be found in the fact that fur on animal when exposed to the sun is degraded much less than the same on fur coat

It is not possible to deal with all the ramifications of cellulose study in a short review like this This is only a summarised report on the subject, leaving aside the detailed accounts related to hygroscopicity, swelling, X ray diffraction, formation of derivatives, dye affinity, resin bonding, effect of non cellulosic constituents and so on, all of which form other interesting chapters of the long story of cellulose

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CULTURAL DYNAMICS AND ACCULTURATION

NABENDU DATTA MAJUMDER

THE second quarter of the twentieth century is marked by striking refinements and innovations in the anthropological approach to the study of culture, based on a combination of the historical and functional methods which has resulted in a renewed emphasis on a field of anthropology known as Cultural Dynamics in general and Acculturation in particular This emphasis recognizes a new, in a fresh form, the principle of universal fluidity and changeability enunciated by Kapila, Buddha, and Heraclitus in the seventh and sixth centuries B C, which has already been accepted by the natural sciences

The reasons for the recent development of interest in such studies are both historical and psychological The first historical root lies in the situation in which anthropology found itself in the first quarter of the twentieth century. The rejection of classical evolutionary views, followed by two extreme reactions in the form of world-wide diffusionism and functionalism, brought anthropology to an impasse There was a feeling of futility and hopelessness in those who were interested in understanding the nature and dynamic processes of culture The rise of the American Historical school emphasizing distribution studies within limited areas in order to understand both historical and functional processes, showed a way out of the difficulty The point of view expressed by Boas in the statement,—"For an intelligent understanding of historical processes a knowledge of living processes is as necessary as the knowledge of life processes for the understanding of the evolution of life forms,"[1] is an index of the growth of new interests which finally culminated in Cultural Dynamics and Acculturation

The second historical reason lies in the completion of European penetration of the far corners of the globe The impact of this factor on primitive cultures in the case of many peoples set in motion a rapid process of change in non literate societies that constituted a challenge to the scientific student of culture The concept of uncontaminated, harmoniously functioning cultural wholes became more and more meaningless, and anthropologists came to direct their attention to changing cultures under contact situations, instead of peoples with undisturbed ways of life

The third and the more positive factor leading to the development of interests in studies of cultural dynamics is a growing anthropological concern with the psychology of culture, resulting from the shift in emphasis from the study of formal aspects of culture to the analysis of cultural change. The understanding of the

reaction of individuals to their ways of life was realized as being of the greatest scientific importance The development of concern with problems of dynamics was to be seen most clearly in the stress laid, after 1925, on acculturation studies This resulted in the establishment, in 1935, of a 'Sub Committee on Acculturation' consisting of R Redfield, R Linton, and M J Herskovits, by the Social Science Research Council of the U S A This subcommittee by defining the concept acculturation and indicating the problems and methods of study, focussed attention to this newly developing subject, and thereby caused its further development

Acculturation, as defined by this committee, "comprehends those phenomena which result when groups of individuals having different cultures come into continuous first hand contact, with subsequent changes in the original culture patterns of either or both groups" For further clarification of this concept, a note was appended saying

> Under this definition acculturation is to be distinguished from *culture change*, of which it is but one aspect, and *assimilation*, which is at times a phase of acculturation It is also to be differentiated from *diffusion*, which, while occurring in all instances of acculturation, is not only a phenomenon which frequently takes place without the occurrence of the types of contact between peoples specified in the definition above but also constitutes only one aspect of the process of acculturation [2]

This definition of acculturation was soon found to require revision in the light of fresh materials It was maintained that the qualifying clauses "continuous first hand contact" and "groups of individuals" should be modified to cover those acculturation situations where the contact is neither continuous nor between groups Herskovits has drawn attention to the situation in the island of Tikopia, where aboriginal patterns are being invaded by European culture elements as a result of "the visit of the mission boat once or twice a year, and the work of a single missionary (a native of another island and not himself a European)"[3] Linton speaks of the difficulty in exactly delimiting the frame of reference established by the phrase "continuous first hand contact" He says

> The observed cases of contact between various groups show all degrees of closeness and continuity They form a series within which there are no obvious lines of demarcation and the limits of acculturation on this basis must be left vague [4]

Greenberg has pointed out the case of the amalgamation of Mohammedan and aboriginal belief among the Hausa, where the acculturative agents are Koranic texts and native learned men, known as Malams [5] In view of the difficulties presented by these new materials, Herskovits has suggested that "the definition be re-phrased so as to emphasize the continuous nature of the cultural impulses from the donor to the receiving group, whether this be at first hand or through literary channels"[6]

Acculturation, it must be stressed, is but one element in the study of culture-change or Cultural Dynamics, which includes changes of all kinds, whatever reason they may be due to Broadly speaking, there there are two classes of forces or stimuli, external and internal, which bring about a series of readjustments leading to cultural change The external stimuli are supplied by the process of culture borrowing or diffusion The internal stimuli are provided by innovations from within a culture, that, is by discoveries and inventions

Culture borrowing or diffusion is of major importance in cultural change In spite of the "psychic unity of mankind," conceived of by the evolutionists, inventions and discoveries take place in a given culture but rarely Culture borrowing is a much easier task, and goes on almost constantly all over the world through peaceful or hostile contacts The pan Egyptian theory of the British diffusionists or the *kulturkreise* of the German Austrian Culture Historical School may be rejected, but the role of diffusion as a significant factor in cultural change cannot be doubted Peaceful penetrations and military conquests have, throughout history, made cultural readjustments inevitable

The main distinction between studies of diffusion and acculturation studies, actually, lies in the methods employed in each The former depend on the assumption of historical contact between different peoples from cultural similarities, while the latter work on the basis of real history derived from historical (*i e*, source) materials as well as contact situations where culture borrowing is in progress In other words, observed phenomena, as against assumed ones, form the subject matter of acculturation

The scientific contribution of acculturation studies does not lie in their concern with the *fact* of culture borrowing when two social groups come into contact, but with finding the *conditions* and *processes* under which culture borrowing leading to cultural readjustment takes place The special significance of acculturation studies may be said to be threefold

(*a*) Acculturation facilitates the comprehension of the nature and processes of culture As the fundamental mechanisms involved in the origin and growth of culture usually lie dormant in relatively stable cultures, it is very difficult to understand these mechanisms by studying stable cultures alone But when a culture is undergoing transformation due to the impact of an alien culture, the usually hidden, fundamental mechanisms come to the surface and operate visibly In such a situation, it becomes easier to grasp these mechanisms

(*b*) Acculturation studies, by illumining contemporary processes and their effects, would throw light on events of past epochs For, the same mechanisms must be assumed to have been in operation in contact situations of antiquity In this respect, there is an analogy between the method of geology and that of acculturation In pointing out this analogy Hallowell says

One is reminded here of the doctrine of uniformitarianism enunciated by Lyell when he wrote his *Principles of Geology* over a century ago. Whereas earlier geologists had sometimes invoked specific explanations (for example, catastrophies) for certain past events, Lyell emphasized the fact that the same processes must be assumed to be operating in the past as at present. By carefully observing the effect of contemporary processes we will be in a better position, he said, to understand the events of past epochs. This principle has become well established in the natural sciences and is just as applicable in the scientific study of man.[7]

(*c*) Acculturation studies have made it possible to effect a great methodological advance in anthropology by introducing the element of historic control, approximating a laboratory situation. This methodology, which is a combination of ethnographical and historical methods, has been termed "ethno historical method" by Herskovits, and well illustrated in his study of the Negro in the New World.[8] In his Afro American studies Herskovits has drawn on both historical documents and ethongraphic data to determine the African cultural background or baseline from which New World Negroes came. It is from this baseline that he has tried to measure the changes taking place in Negro life in the New World as a result of their contact with European cultures. Schapera also has followed essentially the same method in his culture contact studies in Africa, though he has not called it ethno history.[9]

The specific problems which anthropologists, interested in cultural dynamics, are endeavouring to solve may be enumerated as follows:

(*a*) What happens when two social groups with different cultures come into contact?

(*b*) What determines the acceptance or rejection of cultural traits in the process of culture borrowing?

(*c*) What are the mechanisms involved in the acceptance of new elements?

(*d*) Are new elements accepted entirely or partially?

(*e*) How are new elements integrated into the receiving culture?

(*f*) Do new elements undergo any change in form or meaning or both in the process of integration?

(*g*) Are some aspects of culture more liable to change than others?

(*h*) Is it possible to formulate any general laws of cultural change?

A satisfactory answer to these questions will have to wait till acculturation studies are made in different parts of the world to a much greater extent than have been made at present. Only the initial steps have been taken in this direction.

Certain theoretical concepts, already developed by students of acculturation, may be mentioned here.

(1) *Culture borrowing is selective.* Different aspects of culture are differently affected in accordance with the particular historical situation under which contact occurs. As a rule, in conditions of voluntary borrowing, the focal area of culture, that is, those aspects which interest the people most and are constantly in their consciousness, will exhibit more changes than the areas outside the "cultural focus." The term "cultural focus" has been defined by Herskovits as "that phenomenon which gives a culture its particular emphasis, which permits the outsider to sense its special distinguishing flavour and to characterize its essential orientation in a few phrases."[10] But in those situations where force is applied to one of the parties in contact, the focal area seems to offer the greatest resistance to change, and consequently retention of original customs will be strongest here. The point has been demonstrated by Herskovits in the case of New World Negroes who, though they have lost the economic and political aspects of their African cultural heritage, have retained a great deal of their religion (which is the cultural focus of the African Negroes) in spite of heavy pressure on the part of Christianity.

(2) *Syncretism* and *Reinterpretation* are two of the important mechanisms through which the retention of original customs as well as the acceptance of new elements are facilitated. The process of syncretism has been defined as "the tendency to identify those elements in the new culture with similar elements in the old one, enabling the persons experiencing the contact to move from one to the other, and back again, with psychological ease."[10]

The identification of African deities with saints of the church in catholic countries of the New World, and that of the Hausa *iskoki* with the Mohammedan *jinn* are instances of syncretism. The writer has discovered the same tendency among the Santal when they indiscriminately apply the Hindu word *Thakur* and the Munda word *Sing Bonga* to their High God *Chando*, or when *Chando* is syncretized with the Hindu deity *Rama* under the name *Ram Chando*, and when they accept *Kali*, *Dharitri*, and other Hindu deities in their pantheon of *bongas* or spirits.

In a situation where pressure is applied to one of the parties in contact, and the new element demanding acceptance is too divergent to allow of identification and syncretism with the old ones, the mechanism of retention through reinterpretation comes into play. This mechanism consists in reinterpreting the *meaning* of the pre existing element in such a way as to suit the *form* of the new element that has to be accepted. When the American Negroes had to accept monogamy, they reinterpreted their traditional polygeny as successive, rather than simultaneous, plural matings, thereby accepting the new and retaining the old custom at the same time.[11] In the case of the Christian Santal, an attempt has been made to reinterpret the traditional Supreme Being, *Chando*, in such a way as to include the three aspects of the Holy Trinity. Again, *Ram Chando* of the Hinduized Santal has been reinterpreted by one native leader to cover the reinterpreted *Chando* of the Christian Santal, thereby providing an instance of double reinterpretation.

(3) Though continuous first hand contact between two cultures creates a condition favourable for acculturation, and generally leads to reciprocal borrowing of cultural elements, yet of itself it is not a sufficient cause for any radical readjustment in the way of life of either group in contact This is apparent when in studying the Santal we consider the following facts

(a) Though the Santal have long been dependent on Hindu and Mohammedan weavers for the supply of their cotton cloths, they have not cared to learn the art of weaving (b) Though every Santal village has a resident Hindu blacksmith for making and repairing their ploughshares, the Santal have not cared to learn this art in spite of generations of socio economic interaction with Hindu blacksmiths

This principle is also exemplified by the contact situation prevailing among the four Nilgiri tribes, Toda, Badga, Kota and Kurumba These tribes have been living in "economic and social symbiosis" without attempting to learn each other's special occupation [12]

(4) Hallowell has put forward the following two concepts (a) Learning exercises a great influence in acculturative as in all other situations involving the transmission of culture The existence of incentives to learning promotes acculturation, while barriers retard it (b) Acculturation under conditions of voluntary learning is not disruptive [13] It has been observed by the writer that the Santal of Birbhum, living in villages near the educational institutes of Santiniketan and Sriniketan, are being encouraged to learn weaving, carpentry, and cultivation of new crops They are learning these and other new elements without any radical change or disruption in their mode of life

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RECENT ADVANCES IN APPLIED MICROPALEONTOLOGY AND MICROPALEOBOTANY

H S PURI AND J SEN

CALCUTTA

I Micropaleontology

(a) *Introduction and Origin of Micropaleontology*

MICROPALEONTOLOGY, a science dealing with fossil remains of organisms of the past, their structure, genetic relations and distribution in space and time has demonstrated great usefulness particularly in petroleum discovery and recovery The microfossils, especially *Foraminifera*, have been of inestimable practical value in oil geology as 'index fossils' because of their smallness and abundance which makes it possible to analyse their distribution by means of statistical methods These tiny little 'medals of creation' which once were the pastime of 'naturalists' whose interest was limited in the description, general classification and distribution of these forms, were taken little notice of until a few decades back when their value in stratigraphy was recognised Chapman (1902) was one of the first to recognise their importance in stratigraphy and in his opinion "the remains of *Foraminifera* found in the various fossiliferous strata of the earth's crust are often of great importance to the stratigraphical geologist" J A Cushman was one of the first to establish the value of foraminiferal studies in the field of economic geology while Galloway began at the same time micropaleontological examination of samples from oil wells in Mexico for practical purposes of stratigraphic correlation In Texas, as early as in 1921, applied micropaleontology was well established when the oil companies based their geological interpretations of rocks on their 'restricted' assem-

blages of Foraminifera examined by their research staff This led to the economic application of micropaleontology in all countries where oil is produced or where exploration for oil is being carried out

The small size of the fossils led to the development of a special technique of collection, preparation and examination of material and these methods are now standardised though they remain flexible to be applicable to great variety of natural conditions

The abundance of microfossils which necessitated organized work and progressed so rapidly that flood of micropaleontological literature accumulated during the last few decades has become more difficult to handle than the material itself Steps have been taken by Ellis and Messina (1940) to overcome this obstacle by their efficient and co ordinated work of issuing a catalogue and bibliographic service which serves as a clearing house for this bulky literature The department of Micropaleontology of the American Museum of Natural History has started the publication of an international news quarterly, *The Micropaleontologist*, with the hope to maintain a closer liaison between workers in the field of micropaleontology and to avoid duplication of effort and to stimulate discussion on matters relating to taxomony and nomenclature and publication of new techniques, procedures as well as personal items concerning workers in this field The department has emphasized to enlarge their depository of topotype material maintained for exchange and for the use of their subscribers by inviting samples of any washed material for the depository which it is hoped will further the cause of micropaleontology

The smallness and abundance of microfossils lends itself well to the statistical methods of investigation which have been successfully used Quantitative methods represent a better approach to the problem of getting the most accurate information from paleontological materials The fundamental factor in any quantitative analysis is embodied in sampling theory in which only a part of fossil population is studied since it is quite impossible to study all the members of a population and again it is rather impossible to study enormous number of individuals that are present This has made it necessary to study a relatively small sample from a certain outcrop which would give as much information as a comparatively bigger sample

The difficulties encountered in economic application of micropaleontology has led to a private system of index numbers or letters instead of scientific names for species and 'type' specimens of these species are kept for reference in a private laboratory, while in academic field, an intensive campaign of description and publication of microfossil assemblages has contributed the bulk of about 300 new genera and about 5000 new species of Foraminifera during the past fifteen years

Micropaleontology in its early days was mainly concerned with finding 'marker horizons' in oil fields and as these markers could be based on the presence of certain distinctive fossils in local or regional stratigraphic sequence or on their absence in some other part, little or no significance was attached to the research work, to the factors responsible for limited range of such 'Markers', their nomenclature, distribution, paleo ecology and paleo geography Since the correlation was required only in limited oil bearing structure or oil field, little was done in the way of regional correlation, on the significance of the distribution, of faunal assemblages and faunal facies Recent works on the morphology of Foramanifera, including statistical analysis of morphological features in successive populations, the paleo ecology of microfossil assemblages and the significance of their distribution, the ecology of the recent Foraminifera and the distribution of modern faunal facies and their correlation with the various water masses, with bottom sediment conditions and their comparison with fossil assemblages, on various phases of evolution of microfossils and on their succession of intercontinental or even world wide geographic and geologic range and on biostratigraphy have undoubtedly brought micropaleontology in line with the main trends of modern paleontology Practical application of micropaleontology to solve complex geological problems and making regional correlations possible, has widened the theoretical foundation and has also improved the apparatus of micropaleontological research besides a detailed morphological analysis which has become the basis of taxonomy

(*b*) *Microfossils—Foraminifera*

A considerable amount of work has been done in the last few decades on the morphology of the test, the composition and the structure of the shell wall by several workers but the problem of a commonly acceptable classification of Foraminifera is still unsolved as the practical workers who are quite familiar with the foraminiferal contents of the geological column and are the obvious workers to study the phylogeny of Foraminifera seldom have an opportunity to do this kind of work since they are mostly occupied by their routine work The ideal team for such a kind of research will be protozoologist and practical micropaleontologist with an interest in paleo-ecology A more natural cassification done for the sake of better understanding of the phenomenon of foraminiferal evolution and also for taxonomic reasons is desirable and to attain this Voorthuysen (1948) has expressed the need of building up of a "more natural classification" of the Foraminifera Hofker (Voorthuysen 1948) on the basis of internal structure alone intends to build up a new classification which it is hoped will give us a better understanding of the phylogeny of the Foraminifera, will remove the existing taxonomic confusion and will also increase our knowledge of the paleo ecology But a classification based both on inner and outer structures of Foraminifera such as the one introduced by Hoglund (1947) will be more natural Recently Wood (1949) has shown that the microstructure of the test is of taxonomic importance. Glaessner (1945) has stres-

sed the need of a fuller description of a new species based on thorough study of several individuals of a newly discovered population "with definite indications of the interaspecific range of variations" and German micropaleontologists in their agreement of a "standard" of the availabity of at least ten well determinable specimens to define a new species is a good start (Hecht 1948) and Hecht's suggestion that the consideration of stratigraphic range in the definition of a species will lead to a vicious circle will certainly be welcomed by many. All we want is a natural classification which can only be attained by a closer co operation of protozoologists and practical paleontologists.

(c) *Paleo ecology and the Foraminifera*

Considerable amount of work has been done on paleo ecology, the science of fossil organisms in relation to their environment at the time of their existence, death and burial in the sediments which is governed by three main factors which reflect considerably in the composition of a *faunule*—an assemblage of fossils preserved in a stratum of limited vertical and horizontal range. *Biocenosis* or the condition which enabled the association of animals in the area of sedimentation, circumstances which led to the burial of certain assemblages consisting of indigenous as well as exogenous fauna and the conditions of fossilization are the main factors responsible for the distinction of biofacies assemblages formed at the time but under different conditions. The biofacies do not always or entirely depend on rock facies since contemporaneous lithologically similar deposits formed under similar physical environment often have different biofacies. Thus the discovery of a distinctive fossil faunal assemblage is nothing more than an indication of probable occurrences in adjoining areas of either identical or entirely different contemporaneous assemblage in every single basin of deposition which normally include near shore and off shore areas, shallower or deeper zones, warmer or cold regions, embayments and also areas influenced by currents. Since facies change both horizontally and vertically and these changes do not proceed everywhere at the same rate and time, faunal changes in successive strata are not only due to organic evolution but also to stratigraphically significant ecological differences which generally account for the changes in the composition of fauna due to the sudden appearance of ecologically distinctive dominant elements which may serve as local or even regional time markers. Faunal zones may be recognised in one type of facies but in another type, a uniform fauna throughout the sequence may not give any indication as to the difference in age of older and younger beds.

Paleo-ecological analysis of faunal assemblage based upon a comparison with recent foraminiferal assemblages living under known conditions has made it possible to establish stratigraphic relations by ignoring divergent ecological elements. Such an analysis is useful not only in an investigation of conditions of deposition but also helps in determination of similarities and differences between foraminiferal assemblages which can be interpreted in terms of stratigraphic classification. Unfortunately the available information on the influence of individual environmental factors of which temperature, depth, salinity, food, light and oxygen contents are the most important is limited but steps have been taken by the Woods Hole Oceanographic Institution to further our knowledge of modern ecological conditions (Phleger 1948). Some of these factors effect the distribution of species and genera and perhaps families and even larger taxonomic units which are dependent on ecologic conditions.

Certain bionomic group, like the planktonic, primitive arenaceous, imperforate calcareous, attached, brackish water and the larger Foraminifera which are not necessarily taxonomic units have been recognised where no clear analogy between the composition of the entire fossil and living faunas could be established. Some of these bionomic groups have been subdivided into smaller units depending on their distribution upon special ecological conditions for example assemblage with abundant *Epistomina* occurring at the same time and some what different assemblage without *Epistomina* in the Middle Jurassic, Hautervian and Albian of Northern Germany (Hensoldt 1938).

(d) *Correlation*

Microfossils have been used with great success in establishing age relations between various sedimentary rocks, in identification of discontinuous parts of originally continuous beds in surface outcrops or bores and in the description of their sequence and structural behaviour because of their abundant occurrence, even distribution and the possibility to obtain them from small rock fragments and drill cores.

Stratigraphic approach in micropaleontology lies in the identification of microfossils as 'indices' and that the strata containing them occupy a definite place in the geological succession. The terminology for the units in the chronologic scale is under discussion but the following terms for the subdivision of the geological time as well as for units of the rock sequence (Schenck & Muller 1941) has been in use

Time	Time Rock
Era	*Group*
Period	*System*
Epoch	*Series*
Age	*Stage*

Stages have been subdivided into *zones* which are usually named after characteristic fossils which may or may not be restricted to it and is distinguished from others by the distinctive fossils it contains. The difference between successive *zones* are caused by evolution, migration or extinction of forms and rapid environmental conditions create *faunal zones* characterised by distinctive fossil assemblage while the evolutionary changes create *biozones*.

Local correlation and identification of strata based on faunal zones has made it possible to assign these zones to topographically or structurally isolated strata The correlation depends more on the corresponding discontinuous in the vertical section rather than on similarities between correlated zones and also on the relative frequencies of forms present. Regional correlation based on faunal evidence extending over large areas have been attempted with success in the Gulf Coast, Central America, California, the Indo Pacific Region, The Caucasian Region, Northern Germany and the Anglo Franco-Belgian Tertiary basin The original microfaunal stratigraphic classification has produced some of the most valuable contribution to geology which micropaleontology can make and six divisions ('a'—'f') have been established in the Tertiary of the East Indies (Van der Vlerk and Umbgrove 1927) each of them defined by a different combination of Nummulitic, Orbitoidal and Alveolinid genera and Glaessner (1943) has attempted a stratigraphic correlation in the Indo-Pacific based mainly on larger Foraminifera

II Micropaleobotany

(Spores & Pollens)

(*a*) *Introduction* —During the last thirty five years the study of plant microfossils has been greatly stimulated by its application to the problems of stratigraphy, paleogeography, paleoecology and phylogeny of the plant groups that yielded microfossils in ancient sedimentary deposits The microfossils with their distinctive structures are highly resistant to decay due to the presence of cutin and lignin-complex, so that they are permanently entombed under the continued sedimentation Fragments of these rocks, clay or peat, may yield wealth of microflora representing the floras of the past When systematically investigated these floras may yield valuable informations pertaining to the various problems of geology and botany

The origin of this branch of comparatively new science perhaps dates back to about 115 years when Witham (1836) noted plant microfossils in coal Since the time of Witham many workers have made casual observations of microscopic remains of plants in sedimentary strata Among others Dawson, Reinsch, Früch, Weber, von Post (1916-30) and Lagerheim have distinguished themselves in the field of micropaleobotany during the early period of development of this science, but the last two authors continued to contribute until recently The renaissance period of micropaleobotanical studies began since these microstructures became of practical and economic value and many investigators have now joined this field of investigation in different parts of the world

The nature of microfossils and the types of rocks in which they are embedded necessitate wide variations in the methods of study involving different techniques Such techniques have been evolved by different workers to meet the requirements of specific nature of study. Wilson (1944) and Erdtman (1943) recently made short reviews of the methods in micropaleobotany

The present discussion includes only the spores and pollens as microfossils, to the exclusion of all other types of microflora, and their importance in the field of applied micropaleobotany so that the readers may not fail to appreciate the more important aspects of the subject

In the field of stratigraphy, micropaleobotany has not yet been given its proper recognition as enjoyed by micropaleontology and other methods of approach This is partly due to the difficulty in classification and identification of the plant microfossils In spite of these difficulties voluminous literature on fossil spores and pollens have now been accumulated and intense researches are in progress in different countries to develop the science into a thoroughly practical method It now remains to systematize this knowledge to the best advantage of stratigraphical problems The unique advantage of plant microfossils over animal microfossils is that among others the microflora usually occur in coal and peat in addition to the associated strata, and that they are usually preserved better and occur more widely in various types of sedimentary deposits

(*b*) *Microfossils in coal* —In U S A Reinhardt Thiessen (1913 41) and his associates are perhaps the first to establish methods in the preparation of thin sections of coal to make use of such microfossils (*e g*, megaspore) as a basis of correlation of coal seams They prepared a series of thin sections of coal from floor to roof and took records of the percentage of occurrence of the different spore types found therein, and finally correlated the coal seams on the data thus obtained The outstanding defect in Thiessen's method is that in thin sections of coal only a sectional or one view of the spores may be studied, and as such they are not easily and positively determinable

In England, Evans and lately Slater, Evans and Eddy (1930) made similar studies A few years later Raistrick in collaboration with Simpson (1933) began to develop a new method of correlating coal seams They separated the microspores in coal by chemical treatment to obtain different views of the spores for correct determination and placing them under some numerical names The microspores were counted to give a diagram showing the proportions in which different spore types were present in the coal under investigation When a number of such diagrams were prepared and compared from different coal seams it was usually expected that the diagrams of a particular seam should be similar, but sharply different from those of the other seams This is partly due to probable wind dissemination of spores as a result of which the spore-content of a particular seam tends to be uniform horizontally "If any group of fossils, plants or animals, was evolving at a fairly rapid rate during the deposition of Coal Measures (or, of course, any other strata), so that the period of time covered by the forma-

tion of the strata is sufficiently long for the group of organisms to undergo considerable progressive changes, it should be possible to sub divide the strata into separate zones in the changes shown by the fossils or their spores The deposition of the Coal Measures took millions of years, and as such there is considerable difference between the members of different plant groups and their spores occurring in the earlier strata of the period, and those in the later strata, and such differences can be profitably used to sub divide and to correlate the series" Since the memorable researches of Raistrick (1931 39) many authors contributed largely to establish the micro spore method into a thoroughly practical one

According to Naumova, (1937) in Russia "The Geographic complexes of spores and pollen distinguished makes it possible to establish the largest stratigraphical sub division of the coal bearing beds and to correlate individual horizons within the bed"

In India, similar work is in progress in the Raniganj and Karharbari Coal fields, and a preliminary report of such work in the disturbed eastern part of the Raniganj Coal field has already been published (Sen, 1944)

In America the limitation of Thiessen's thin section method was soon realised, and before his death Bentall applied chemical method to isolate the spores for stratigraphic work in Tennessy Coal field Similar work is in progress in Illinois, Iowa, Pennsylvania and West Virginia, and the results are highly convincing (Wilson, 1944)

So far very little work has been done on Cretaceous and Tertiary Coal But work is in progress in different parts of the world to use micro fossils for the study of these younger coal fields In India the work on the stratigraphic position of some Assam Tertiary coal seams has been provisionally established (Sen, 1949a)

It has also been noted that some spores have restricted vertical range of distribution These spores are referred to as *zone fossils*, and are usually of high correlative value Such spores used as *zone fossils* have been recovered from the Coal Measures in different parts of the world

Spore flora has been more profitably used in Russia to establish the geological provinces of the Moscow Basin, Kaizel Basin, the Pechora River, the Voranezh region, Berchogur deposit, Spitzpergen (Town of Pyramids), Northumberland, the Karaganda Basin, Donetz Basin and several others of Carboniferous age (Wilson, '44)

Results obtained by Raistrick, as already indicated, laid others to suggest fuller exploitation of spores in stratigraphic problems of coal fields Turner has discussed the scope of micro-spores and made the interesting observations that "if each seam of coal contains a definite and invariable suite of microspores, the mining engineer will have in his hand another means of determining the coal seams found in an unproved area" Similarly, the identification of a seam across a fault may be determined by microspore analysis (Wright) In India this fact has actually been proved in the eastern part of the Ranigunge coal field In the absence of any other paleontological evidence, microspore analysis can be used to identify a seam (Trueman)

In addition to their value in correlation work microfossils are also of great use in the study of certain other aspects of coal petrology In America, Roos (1937), studied the various uses that can be made out of residues obtained from maceration From the examination of maceration residue he attempted to determine the nature of coal and drew some interesting conclusions from his results Predominance of spores and cuticles refer to durainous coal, and those of resinous and bituminous bodies indicate a major occurrence of vitranised element Theissen and Sprunk (1935) classified bright coal on such characters as the richness of spores etc In India similar investigation is being continued on Raniganj, Barakar and Karharbari coals (Sen, 1949b)

(c) *Microfossils in younger strata*—The importance of microfossils in the pre Quarternary stratigraphy has now been fully realised, and workers are now engaged in exploring all such possiblities Such and other associated problems in pre Quarternary and Quarternary Geology will be discussed in the succeeding paragraph

Sahni in collaboration with Sitholey and Puri (1947) has worked on the correlation Tertiary succession in Assam by means of microfossils, and the preliminary results of the investigation show remarkable possibilities of correlation in all such work Not only certain major groups have been recognised on the basis of characteristic microfossil types which seem to be confined to them but smaller divisions have also been recognized within each major group based partly on the absence of certain forms and partly on the relative frequency of those present The result seem very promising and may indicate a new means of correlating Tertiary rocks by microfloral assemblages

(d) *Microfossils and the measurement of geological time*—The possibilities of paleontological approach with special reference to microfossils for the measurement of geological time in India has recently been reviewed by Sahni (1947) He is perhaps the first worker to explore such possibilities, and before his untimely death did much to establish the usefulness of microfossils as age and horizon markers specially those of the apparently unfossiliferous and partly metamorphosed deposits Sahni (1946) and his students recovered Eocene microfossils from the long known unfossiliferous Saline Series (Cambrian) in the Salt Range of the Punjab

This discovery led the geologists to re-examine the field evidences in the light of Sahni's researches,

Examination of control samples from the undisputed Cambrian beds overlying the Saline Series (Ghosh, Sen & Bose, 1948) although necessitate the re examination of Sahni's views, yet it is a case in point to show the immense importance of microfossils in the measurement of geological time

Sahni (1947) further pointed out that very useful results may be obtained in microfossil investigation of Indian sedimentary deposits of unknown or disputed age, some of which are traversed by intrusive igneous rocks, such as the Cuddapah, Vindhyan and other formations in the Indian peninsula, various pre-Carboniferous sedimentaries in the Himalayas whose age is open to doubt, strata in the Poonch State and adjoining areas, Upper Gondwanas of the Coromandel coast, certain beds in the Solan Simla area and in the Kosi area of the Eastern Nepal and the Cardita beaumonti beds bearing on the age of the Deccan trap Similar work is in progress in India and elsewhere with very promising results

(e) *Microfossils in phylogenetic studies* —The scope of the present article does not include any consideration of the bearing of microfossils on the evolution of the various plant groups from the Paleozoic to the recent Lack of knowledge of our modern spore and pollens and difficulties in the specific identification of fossil ones offer little help to our ideas as to the evolutionary trends of the plant groups But continued work has shown that the microfossils may be of real help in phylogenetic studies if considered along with the megafossils, and such possibilities are now being explored by workers in different parts of the world

(f) *Other problems of correlation* —In recent years there is growing interest in correlating microfossil studies to various geological, geographical, ecological, archæological and climatic problems The possibilities of microfossils in all such correlations diminish rapidly with the increased age of the rocks and decreased knowledge of plants

The results obtained by Raistrick from the British Paleozoic coal definitely show forest succession In India, Ghosh & Sen (1945) also explored such possibilities from their studies of Raniganj coal microfossils These authors successfully correlated their observations with stratigraphical succession of the Glossopteris flora upto a limited vertical distance, and confirmed the already speculated climatic condition during the formation of the Raniganj sediments of Lower Gondwana age Similarly Shani's (1945) idea as to the range of the *Glossopteris* has been partly confirmed by the discovery of *Pityosporites* a few feet above the Talchir Boulder bed The other important attempts to correlate pollen flora to ecologic conditions in pre Quarternary deposits have been made by Wodehouse (1933) and Simpson (1936) working on Eocene oil shale and coal respectively of America

Work on correlations in similar line has been done with remarkable success in Europe on Quarternary deposits The pollen grains have been used as guide fossils, their frequencies and occurrences, both vertically and horizontally, are computed into pollen spectra, or groups of such spectra, exhibited by the curves in the pollen diagrams

von Post (1916-1930) is the pioneer master in this field of investigation He established paleofloristic levels in several Swedish lake deposits and proved that two isochronous beds usually contain same pollen deposits

The most facinating and interesting results obtained by von Post led among others Lundqevist (1920) and Erdtman (1921) to this branch of floral correlations

Before getting into the specific aspects of correlative value of Quarternary pollen analysis it should be clearly understood that even a skeleton review of the voluminous recent literature on these problems is not possible here, and as such the readers are referred to the reviews by Cain (1931), Sears (1935 1942) and Wilson (1944) on American deposits, and those of Godwin (1934) and Erdtman (1943) on European correlations, for detail informations Since the publication of Cain's review, Wilson (1944) summed up the work by investigators in North America as (i) extending the geographic range of peat studies, (ii) investigating the interglacial peat deposits, (3) correlating the pollen spectra by stratigraphic methods, (4) tracing the post glacial migration of forest elements, and (5) testing out theories of climatic sequence In Europe, the work can be summed up under the following heads (i) *Paleoclimatology* The classical work of Blytt (1876) and Sernander established, "at least so far as extra mediterranean Europe is concerned, to adopt the division of the postglacial period into the climatic phases Pre Boreal, Boreal, Atlantic, Sub-Boreal, using them also to indicate the period of time" These phases were later modified from time to time in different places (ii) *Geology & Archæology* Interglacial epochs and stages of the postglacial period may be correlated with pollen spectra or diagrams, as the case may be The pollen flora may also positively establish an exact geochronological time scale into vegetation history This line of research has been laid down by Fromm (1938), de Geer (1940) & others

Possibilities of similar work in the Karewa series, and in the sub recent peat deposit of Kashmir, hold promise for a close dating of principal geological and climatic events in this area during the past few million years (Sahni, 1947) Erdtman (1943) further pointed out that correlation may be further established with eustatic changes of sea-level, as shown by intramarine deposits, submerged peats etc, with isostatic changes of level, with situations arising out of eustatic isostatic complex Similarly from tabutated account of pollen spectra or phases of a pollen diagram of a peat deposit any archæological object may be dated with remarkable accuracy Such correlation sometimes have serious limitations whenever there will be a case of forced introduction of some object into any other foreign peat layer. The literature on regional pollen analy-

tical dating have been reviewed by Erdtman (1943) Similar ecological correlations by analysing pollens in varved sediments as indicated above may be laid out without difficulty

(*g*) *Problems of classification of spores and pollen* Another important drawback of the pollen analysts in general and those of old workers in particular is that of a lack of a natural system of classification, so far as the Quarternery pollens are concerned, most of the species are referable to modern genera and as such there is no chance of confusion But much difficulties are encountered in classifying the Paleozoic forms and most of the Mesozoic ones The recent classifications of Paleozoic spores by Schopf *et al* (1944) and Naumova (1937) have put some provisional arrangement, but still more yet left to be explored for maximum utilization of such microfossils In India Sahni accepted Naumova's classification for spores recovered from Indian Paleozoic sediments (See *Science & Culture*, May 1949, p 463)

Conclusion

The article represents a first and necessarily an inadequate attempt to combine the very diverse methods of application of microfossils in one discipline *viz*, Applied Micropaleontology Very little work has been done in India in this line and this apparent neglect is due to the fact that the value of microfossils has not yet been fully understood and that it lacks support by the appropriate authorities Greatest hurdle that has to be crossed to remove this neglect is to train suitable personnel by including micropaleontology and micropaleobotany in our curricula of studies in Anthropology, Archæology, Botany, Geology, Geography and Zoology in the post-graduate classes and to provide research facilities in our Universities A beginning in this direction has already been made at Banaras, Dhanbad, Calcutta and Lucknow and a vast field is open for our young men and women with a scientific background Workers in India also strongly feel that a start is made with a separate section on micro fossil (floral and faunal) researches at the newly established Institute of Paleobotany at Lucknow and in the Geological Survey of India and the Bureau of Mines The existing personnel of one paleontologist and one paleobotanist in the Geological Survey of India is too inadequate consistent with the recent advances in these subjects and their increasing importance in the exploration of such economic minerals *e g*, coal, petroleum etc, and in the problems of Stratigraphical Geology (See SCIENCE AND CULTURE *11*, 330, 1946) It is further desirable that a Paleontogical Society be sponsored like the already existing Paleobotanical Society This will help to co ordinate the activities of various paleontologists in India *

*Our thanks are due to Sri A K Ghosh, Registrar, Bose Research Institute, Calcutta for going through the manuscript and for his constructive suggestions.

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INSTITUTE OF RADIO PHYSICS AND ELECTRONICS

THE foundation stone of the Institute of Radio Physics and Electronics of the University of Calcutta was laid on April 21 last by the Hon'ble Dr B C Roy, Premier, Government of West Bengal, at the University College of Science and Technology, Calcutta Prof P N Banerjee, Vice Chancellor, presided

The Institute which will be an independent two storied building by the side of the *Institute of Nuclear Physics*, the foundation stone of which was laid just a year ago on April 21, 1948 (see SCIENCE AND CULTURE, *13*, 491, 1948) will be the first of its kind attached to a University in India to foster the study and research on the rapidly growing science of Radio electronics

Laying the foundation stone, the Premier recounted the growth of the science of radio electronics and said that its first stage was the development and perfection of wireless telegraphy Many attempts had then been made at this stage at transmitting spoken word across space by wireless telephony But all were unsuccessful Success was attained only with the invention of the triode valve during World War I and this marked the advent of the second stage of development, the age of radio electronics, leading to the phenomenal development of broadcasting and the electrical communication system—long distance trunk telephony Enormous expansion of the radio industry followed

But communication and broadcasting were only two of the many applications of radio electronics Radio electronic devices are now widely applied for industrial purposes, such as regulation and control of power supply, temperature, humidity and, in fact, of any physical agency involved in manufacturing processes Continuing Dr Roy said, "The use of radio electronics for therapeutic purposes was well known High frequency current concentrated at a point provided the surgeon with the electric knife for bloodless surgery It was, perhaps, not generally known that the demand for electrical power for high frequency heating far exceeded that for broadcasting and communication But of the many radio-electronic devices produced so far, none had evoked so much interest as television The present age of Radio Physics development may be said to be the age of microwave Microwave technique developed during World War II were associated with those of Radar which provided invaluable aids in every operation on land, on sea and in air Curiously, microwaves of wave lengths in the centimetric range are just those waves with which Sir Jagadish in this country carried out his experiments on the optical properties of electro magnetic radiation Waves of such short length had, however, found no practical use at that time and were considered to be more or less of academic interest only But, after half a century, they have found intensive applications both in peace and in war I am glad to know that special emphasis will be laid on the research and study of these waves In doing so the Institute will be carrying on the study of a subject, the tradition of which had been created in this country more than half a century ago"

The expansion of air services had entirely been due to safety aids provided by radio electronic devices Air liners in Western countries now moved along highways in the upper air made of radio beams A pilot could land his plane safely even when the runway was hidden by fog A modern mechanized army or an air force was helpless without radio electronic equipment

The Premier, sounded a warning against the misapplication of science in modern life and said that, if science was made a handmaid of political warfare, the result would be disaster The only object of a research scholar and professor was pursuit of truth

Requesting Dr Roy to lay the foundation stone, Prof P N Banerjee, the Vice Chancellor said

"You have been closely associated with the University of Calcutta in various capacities You have been one of our Vice Chancellors and Presidents of the Council of Post Graduate Study and Research You, like us, have seen dreams The foundation stone of the Institute of Radio Physics and Electronics, which I call upon you to lay today, will partly fulfil your dream The laboratory which will raise its head on the foundation stone, which you lay on this sacred spot, will be a symbol of the sacrifices which you and your co workers have rendered to the University of Calcutta and specially the University College of Science ever since its foundation in 1914" Continuing he said that radio as a course of study in post-graduate phy-

sics had been introduced by Calcutta University more than 25 years ago But in view of the enormous development of the subject, it had been felt necessary to introduce it as an independent subject of study for M Sc degree This had now been made possible through the financial aids received from the Central Government Due to the generosity of the Government of India, the University of Calcutta received a grant for this new Department of Radio Physics and Electronics—a capital grant of Rs 3,40,000 for building, and Rs, 2,10,000 for equipment It has also been promised an annual recurring grant of Rs 49,000 The University would have, however, to supplement staff and equipment from its own funds

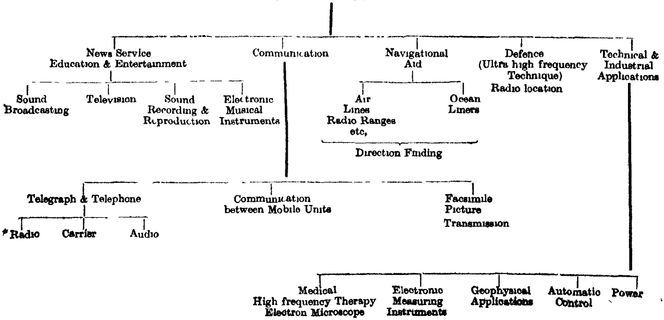
In regard to research work of the University, Prof Banerjee said that in recognition of their work on the ionosphere,—the conducting upper atmosphere region which guides radio waves,—the Council for Scientific and Industrial Research of the Commonwealth of Australia had recently offered on permanent loan a complete ionospheric equipment to the University The University had also received certain equipment free of cost from England It is proposed to build a field station for this apparatus in the agricultural farm land measuring about 450 *bighas* received recently by the University from West Bengal Government at Haringhata Special emphasis, he said, would be laid in the Institute on researches on micro-waves and television

Proposing a vote of thanks in honour of the Premier Dr B C Roy, Dr S K Mitra, Ghosh Professor of Physics, Calcutta University, said

"It is not just an accident that the Institute of Radio Physics and Electronics and the Institute of Nuclear Physics have been founded close upon each other within the brief space of one year and will be built side by side These two branches of Physics have been responsible for the development of the two epoch-making weapons of World War II—the radar and the atomic bomb One is now helping the other in developing new experimental techniques and in finding new peace time applications In the Cyclotron room in the adjoining Nuclear Physics Block, high speed charged particles are being generated for smashing atoms by essentially radio-electronic device The wonderful Electron Microscope set up in another room is also a purely radio electronic apparatus And, in our laboratory, we have been devising radio-electronic equipment for studying some fine properties of the atomic nucleus—the magnetic moment and the electric quadrupole moment—the determinations of which are of utmost importance to the nuclear physicist The two Institutes will always be working in close co-operation helping in each other's growth"

"As has been pointed out, the Institute will be the first institute of its kind in India to be associated with a University But to guard against any complacency, I must add that in the western countries the University is not the only place where radio-electronic research is carried out The subject is so vast and is of such vital importance to national security that the Government of every country maintains, in addition, its own research establishments for special studies, under its various departments—Commerce, Communication or Defence The industries also spend enormous sums of money on research In our country, the only special establishment for radio-electronic research under the Government is the Electronics Division of the National Physical Laboratory I am glad to say that the Division is in charge of an old student of ours Dr H Rakshit"

APPLICATIONS OF RADIO ELECTRONICS



Notes and News

OBITUARIES

Hans Wollenweber

Dr H. Wollenweber, the noted German Plant Pathologist, died at the age of 69 on February 3, 1949, in Washington, D C, U S A Dr Wollenweber at one time of his career served for several years in the U S Department of Agriculture, he left Germany and went back to the U S A in the fall of 1948 to seek American citizenship and settle in peace there Dr Wollenweber was widely known for his book "*Die Fusarien*" on the classification and identification of the species of *Fusarium*

Joseph A Cushman

Dr J A Cushman, a leading authority on fossil and living *Foraminifera*, who was the first to establish the value of foraminiferal studies in the field of economic geology, died on April 16, 1949 He was the founder director of the Cushman Laboratory of Foraminiferal Research, Sharon, Mass,—the only one of its kind in the world According to the present plan, his entire collection will be placed in the United States National Museum at Washington

PROTON AND ELECTRON RESEARCH

Experimental work at the National Bureau of Standards has culminated in the determination of two properties of the proton and electron (1) the absolute value of the magnetic moment of the proton with unprecedented accuracy and (2) the value of the basic constant e/m— electric charge to mass ratio of the electron—with even greater and unprecedented accuracy.

The results are of utmost significance in nuclear and atomic research because important properties of the proton and the electron are known with greater precision and a convenient standard for measuring magnetic fields with far greater precision than ever before is available It is now possible to redetermine all other physical constants whose values depend on the measurement of magnetic fields A method is now at hand for stabilizing magnetic fields at an accurately known value

This basic and far reaching work has been done by H A Thomas, R L Driscoll, and J A Hipple

Using tap water as a proton source the accuracy of the value for the proton gyromagnetic ratio (magnetic moment divided by spin) has been pushed up to better than 1 part in 13,000 or 70 times better than the best previous absolute measurement The value for the magnetic moment of the proton in absolute units $1410\ 0 \times 10^{-26}$ gauss cubic centimeters—is accurate to 1 part in 6,000 The new value for the proton moment is the first precise measurement of this quantity in absolute units All previous measurements of the magnetic moment to any significant accuracy have been made in terms of the relative values of other physical constants For this reason, the new precise knowledge of the absolute value of the proton moment helps to define more clearly the fundamental properties of nuclear particles

Taking the new value of the proton's gyromagnetic ratio as a reference standard, it is then possible to calibrate magnetic fields very precisely in terms of the radio frequency required to produce resonance in a proton sample This is an extremely practical procedure since radio frequencies can easily be measured to a few parts per million with ordinary laboratory apparatus

In the past, laboratory measurements involving both magnetic and electric fields were limited by the low accuracy of magnetic measurements Now the situation is reversed and magnetic fields can be measured more accurately than electric fields The nuclear resonance techniques developed in the course of this work can be applied to good advantage wherever the strength of a magnetic field must be closely regulated

The problem of magnetic field measurement and regulation arises widely in the use of scientific apparatus —cyclotrons, mass spectrographs and beta ray spectrometers—and in industrial equipment—serve mechanisms and electromagnets With the aid of this new method for controlling magnetic field strengths more exact work in many scientific and technical fields can now be undertaken

Of particular scientific interest is the opportunity furnished by this work to examine the accuracy of physical constants, such as the charge to-mass ratio e/m of the electron, whose values depend on magnetic field measurements The measurement of "e-over m" itself has a history of over 50 years in which a great deal of scientific talent has been devoted to measurements of this fundamental constant Quite recently Taub and Kusch of Columbia University have used a molecular beam to determine an exact value of the "nuclear g factor" for protons By combining this value with the new value of the proton gyromagnetic ratio, a new absolute value of e/m for the electron ($1\ 7588 \times 10^7$ emu/gm) has been calcutated to an accuracy of 1 part in 11,000 The value of e/m enters directly into the design of such important electronic devices as cathode-ray tubes, betatrons, and electron microscopes, and the whole field of electronics depends on the behaviour of electrons in electric and magnetic fields (*Chemical and Engineering News*, April 4, 1949)

URANIUM IN SOUTH AUSTRALIA

The exploration of Mount Painter deposits of uranium, 300 miles north of Adelaide and 60 miles east of Copley on the railway to Alice Springs, is one of the major projects of the Department of Mines, South Australia About 160 square miles of rugged country is being examined by prospectors and geologists Sites are tested by diamond drilling and underground development

Uranium deposits near Mount Painter, first discovered in 1910, worked intermittently for radium until 1934 The mineral contained 2 to 5 per cent U_3O_8 and reserves in 1914 were estimated at 300 tons of 0 5 per cent U_3O_8 with 700 tons of 0 74 per cent material lying at the surface

Prior to the 1939 45 war, total production of uranium ore was estimated at 136 tons valued at £ 10,000 In 1944, the Mount Painter deposits were intensively explored by modern methods, at the request of the British Government, with the object of producing 100 tons of uranium trioxide over a period of five years It was estimated at that time that the quantity of readily available ore did not exceed 0 33 UO_3 The cost of this investigation was about £ 65,000

The present exploratory work has been started in June 1946 by means of shaft sinking tunnelling, diamond drilling, prospecting, and geological and geophysical surveys Non fluorescent metatorbenite (hydrated phosphate of copper and uranium) and some autunite (hydrated phosphate of calcium and uranium) occur in the oxidised zone, mainly in crushed granitic and pegmatitic rocks Many of the deposits are capped by hæmatite and limonite, with which the metatorbenite is closely associated

Samples of all types of material thought likely to contain uranium, either from the systematic sampling of underground workings, from bore holes, from geologists, or from prospectors, are first tested by Geiger Muller counters, which measure the radioactivity of any fissionable material nearby Portable counters are carried in the field, while laboratory types are used at the station to obtain some idea of the uranium content of drill cores and of material being mined in underground working Uranium content of mine samples and drill cores is determined by chemical analysis at the South Australia School of Mines Investigations into methods of extracting the uranium from various types of ore are being carried out by the Council for Scientific and Industrial Research and the Department of Mines (*The Chemical Age*, March 12, 1949)

HEAT UTILIZATION IN NUCLEAR FISSION

An experimental atomic power plant is now under construction near West Milton, New York It will use liquid metal to transfer heat created by atomic fission to the heat exchanger, where steam will be produced to drive steam turbine generators It has also been announced by Dr Robert F. Bacher of the Atomic Energy Commission that the reactor in the new plant will differ from most previous reactors in the higher energy of the operative neutrons which are produced in it by chain reaction in uranium

The energy set free by a chain reaction is liberated very close to the place where each nuclear fission occurs and appears as an intense local heating In the reactors built during the War, this heat energy was removed by circulating air or water and the heat thereby was wasted The main purpose of these war time reactors was to produce a new element—plutonium—by the action of the reactor neutrons on the main part of the natural uranium (238)

Dr Bacher referred to the machine now being designed and planned for construction by the Knolls Atomic Power Laboratory as an intermediate reactor —one which operated with neutrons of intermediate energy So far, no reactor has been built to operate in this intermediate energy region The heat energy in this process will be removed by circulating a liquid metal and it is planned to utilize the heat to generate electrical energy (*The Chemical Age*, April 2, 1949)

RADIO ISOTOPES AVAILABLE FREE

The U S Atomic Energy Commission has recently announced that radioisotopes of cobalt, gold, and carbon, —enlisted among the 50-odd elements heretofore sold,— will now be made available without charge to approved cancer reasearch workers Up to this time only iodine, phosphorus, and sodium have been provided free The only cost to qualified applicants will be $ 10 per shipment—which will cover packaging, monitoring, and book keeping—plus the cost of transportation

Allocation of the free isotopes will be made for srudies involving animal subjects, research on basic cellular metabolism of cancerous cells, and experimental programmes designed to evaluate the therapeutic use of radioactive materials Since the radiations they emit may be used to destroy living cells, scientists hope to develop means for concentrating them in cancerous tissue and thus selectively destroying it Distribution is administered by the Isotopes Division, Oak Ridge, Tennessee and the Commission hopes that the research on effective radiotherapy for cancer will be stimulated by the free distribution of radio isotopes

THICKNESS MEASUREMENT BY BETA EMISSION

The continuous measurement of the thickness of sheet materials by a new instrument called the Meta-Ray thickness gauge has been demonstrated recently by the U S General Electric Company By measuring absorption, the device is stated to indicate the mass per unit area of the material under test The new gauge is expected to find application in keeping check of the thickness of metal foils, such as aluminium, copper, tin, brass and steel, being rolled at high speeds It can also be used with plastics, textiles, rubber, and other sheet materials.

In operation, the Meta-Ray thickness gauge measures the deviation from a chosen setting by registering the amount of β rays which the material under test absorbs The source of β rays in the gauge is 2 5 millicuries of strontium 90 Those rays, unabsorbed by the material passing through the gauging head, are gathered in an ionisation chamber An attenuated 90 cycle signal is added in phase opposition to cancel the signal from the ionisation chamber The attenuator voltage is, therefore, a measure of the ionisation chamber voltage, and of the amount of material in the β ray beam

Operating on a power supply of 100 125volts, 60 cycles ± 0 3 cycles, the power consumption of the gauge is about 150 watts The accuracy is said to be ± 2 per cent, while drift is not more than 1 per cent per hour after a 30 minute warming up period Under normal conditions, calibration need not be made more often than once every four hours, (*The Chemical Age*, April 16, 1949)

CHEMICAL CONSTITUENT IN GENES IDENTIFIED

Identification of a chemical constituent of genes was announced recently by A E Mirsky of the Rockefeller Institute for Medical Research at a meeting of the New York Section, ACS Proof that genes consist in part of a substance called desoxyribonucleic acid was offered, though it has been held that genes are nucleoproteins The chemistry of genes and the chemical mechanism of their action within body cells has been virtually unexplored territory heretofore

Dr Mirsky found that the quantity of desoxyribonucleic acid is identical for each cell in a given animal species, although it may vary from one species to another The only other constant factor in the gross composition of cells in any animal is the number of chromosomes

The discovery that purified chromosomes of sperm cells contain only half as much desoxyribonucleic acid as other cells of the same animal proves that this chemical is a constituent of the genes, though probably it is not the only material in genes

Diffferent types of cells, since they vary in weight, contain different proportions of desoxyribonucleic acid, although the absolute amount is fixed for any species of animal The compound constitutes 25 per cent of liver, kidney, and pancreas chromosomes, 38 per cent of thymus chromosomes, and 40 or 41 per cent of the chromosomes in the red blood cells of fish The liver, kidney, pancreas, and thymus gland chromosomes were taken from tissues of mammals

To obtain pure chromosomes Dr Mirsky first ground cells in a waring Blendor and then in a colloid mill, breaking down cell walls and connective tissue The resulting sludge was strained through cloth in order to remove all particles larger than chromosomes, and the liquid which passed through the cloth was whirled in a centrifuge at low speed.

The chromosomes, being the heaviest remaining particles, were concentrated by their inertia at the tip of the centrifuge tube, and final purification was achieved by lowering the salt concentration and reducing the acidity

Chemical investigations have shown also that a fibrous protein is the basic threadlike component of the chromosome, and that this substance is likewise concerned with the over all activity of the cell (*Chemical and Engineering News*, March 21, 1949)

AGRICULTURAL UTILIZATION OF ULTRASONICS

Exploratory studies have been going on for some time past at the Agricultural Research Centre of the United States Department of Agriculture at Beltsville, Marryland on the possible utilization, for agricultural purposes, of ultrasonics—electrically produced high-frequency sound waves Results so far obtained indicate that with ultrasonics a mosquito larva may be killed within 5 seconds and that of a coddling moth in 60 seconds Exposure to ultrasonic vibrations helped DDT particles to break into smaller size than any hitherto obtained

Investigations are in progress to find the possibilities of the application of ultrasonics to the control of insect pests and fungal and bacterial diseases of crop plants, for pasteurization, emulsification, homogenization of milk and milk products, and for producing mutations in grains, bulbs, and other plant parts

AUREOMYCIN A NEW ANTIBIOTIC

A new antibiotic principle active against certain viruses and rickettsia and against both Gram positive and Gram negative micro organisms has been isolated from the substrate of *Streptomyces aureofaceens* by R W Broschard, A C Dornbush, S Gordon, B L Hutchings, A R Kohler, G Krupka, S Kushner, D V Lefemine and C Pidacks of Lederle Laboratories Division, American Cyanamid Company, Pearl River, New York (*Science*, p 199, February 25, 1949)

The work was initiated by the late Dr Y Subba Row and Dr J H Williams

The antibiotic has been named aureomycin from the yellow colour of the parent actinomycete and the golden colour of the crystalline antibiotic It is a weakly basic compound, which contains both nitrogen and nonionic chlorine

DRAMAMINE, A NEW DRUG

The Army Medical Department (U S A) announces the development of a new drug, "*Dramamine*" that acts as both a cure and preventive of seasickness or motion sickness The original research was done by L N Gay of the Protein Clinic of Johns Hopkins University Hospital, Baltimore and Paul Barliner, also of Johns Hopkins. Recent experiments showed almost

total cure or prevention of seasickness among more than 400 passengers aboard on Army transport in heavy seas

USE OF ISOTOPES IN MEDICINE

Paul C Aebersold, Ph D, furnishes specific data on distribution of isotopes for medical and biologic purposes during the past two years Isotopes were distributed from Oak Ridge, Tenn From August 1946 through May of 1948, 21,103 shipments of isotopes for study in animal and human physiology and medical therapy were made Forty three institutions are now using phosphorus of P 32 for medical therapy, 38 institutions are using iodine in medical therapy, 119 institutions are using several of the isotopes in all fields of study including investigative and therapeutic application

Over 70 percent of all shipments have been for investigation in therapy and human physiology, the remaining fields of study have been in chemistry, physics, industrial research and metallurgy Of those used more in medical therapy, I 131 and P 32 account for the greatest part inasmuch as the half life of these I 131 (eight days) and P 32 (14 days) permit a much greater rapidity of decay and therefore shipments are required more frequently Isotopes are being shipped to 30 States in the United States, the largest amount is at present going to Massachusetts Illustrations of uses of C 14 in metabolic studies include (1) Protein metabolism with labeled amino acids—leucine, glycine, lysine and amino adipic acid, alanine, (2) Carbohydrate metabolism with labeled intermediates such as lactic, pyruvic, oxalacetic and proprinonic acid and (3) Fate of labeled fats

Other illustrations of uses of P 32, S 35, Ca 45 are also mentioned The author mentions the fact that investigators in foreign countries can obtain isotopes by application through the Commission Twenty nine radioisotopes of 20 elements which are of particular value in biologic and medical studies are available It is stated that although international distribution has been in effect only 10 months, shipments have already been made to 14 countries The author considers that these studies are opening a new field for specialization known as "isotopology" Although the use of these substances can be fraught with hazard there has been collected a large amount of knowledge on how to control them and with this knowledge and a healthy respect for the materials to be handled, safe conditions of work can be easily established (*Journal of the American Medical Association, 138*, 1222 1225, December, 1948)

HORMONAL TREATMENT OF CANCER

It is generally known that the only hope for cancer depends on the complete destruction or removal of the tumor cell, but cure is difficult, if not impossible, when metastases occurs Therefore, chemotherapy has been resorted to, experimentally, in an effort to find a cure that can be adapted to such a task McCullagh, in a recent paper, states that sex hormones have shown more promise than any other form of chemotherapy He warns that hormonal treatment of cancer is not without dangers, however, if it is used in improperly selected cases, and that the treatment is palliative, not curative

In properly selected cases, the treatment is stated to relieve pain, improve health and prolong life According to Greer profound changes in the breast are frequently in association with certain ovarian or testicular tumors, in some tumors of the pituitary and adrenal cortex, as well as breast hypertrophy in cirrhosis of the liver, malnutrition, in some instances, and during stilbestrol therapy for prostatic cancer Under some circumstances mammary enlargement occurs in association with testicular failure as well as in eunuchoid men treated with testosterone

There are a few reports of the development of human breast cancer following prolonged administration of estrogen, but it is stated that with the widespread use of estrogens more reports of breast cancer would be expected, if they were important as a cause The patients who improve by the castration effects of the x ray are almost entirely in the premenopausal group and unfortunately, beneficial response is considered transient When it was discovered that certain carcinogenic hydrocarbons influenced the growth of experimental malignant lesions, some of these substances were tried in cases of human breast cancer Although it would appear unlikely that excessive rate of growth of malignant breast tissue should be decelerated by substances which at one time accelerated the development of the same tissues, but such is the case

Although favorable reports have been published on cases treated with triphenyl clorethylene, triphenylmethylene, hexestrol and dienestrol, stilbestrol is still the most widely used estrogen Undesirable side effects of estrogen therapy may include loss of appetite, nausea, vomiting, diarrhea, and sometimes edema, which may be important when the myocardium is impaired When high dosage is long continued, menorrhagia is likely to supervene Good results include regression of the primary tumor, of soft tissue recurrences, and of lymph gland and pulmonary metastases Pain from skeletal metastases may be relieved, but favorable response in them, otherwise, is doubtful There is great individual variation in response, but in all instances improvement is transient

The chief danger of estrogen therapy is that growth of an existing cancer may be accelerated in younger women In general, androgens have been found most useful in younger patients and in those who have skeletal metastases Among the most impressive changes following testosterone therapy is a change in the roentgenologic appearance of skeletal metastases In some patients areas of demineralization become denser, suggesting deposition of new bone. The untoward

effects of stilbestrol therapy in men may include nausea, vomiting, the nipples and areolae become dark, and a striking degree of gynecomastia appears Castration and estrogen treatment for prostatic cancer should not replace surgery where surgery holds any promise of cure Impotence is also the rule when stilbestrol therapy is used in men In general the result of treatment with stilbestrol, though slower, are considered otherwise equal or superior to those following castration (*Cleveland Clinic Quarterly, 16,* No 1, p 21 January, 1949)

NEW FELLOWS OF THE ROYAL SOCIETY

At the meeting of the Royal Society on March 17 last, the following were elected to fellowship

Prof J F Allen, professor of natural philosophy University of St Andrews, distinguished for his work in low-temperature physics, especially for his discovery of new phenomena shown by liquid helium

Dr R W Bailey, head of the Mechanical and Metallurgical Research Department at Metropolitan Vickers, Manchester, distinguished for contributions on the behaviour of metals at high temperatures and for advances in design of turbines

Dr F C Bawden, head of the Plant Pathology Department at Rothamsted Experimental Station, Harpenden, distinguished for his work on plant viruses and virus diseases, and for important contributions to the study of virus serology

Prof F W Rogers Brambell, Lloyd Roberts professor of zoology, University College of North Wales, Bangor, distinguished for his experimental studies of processes of reproduction in mammals and of the factors concerned in antenatal mortality

Prof K E Bullen, professor of applied mathematics in the University of Sydney, distinguished for work in geophysics, particularly in relation to earthquakes and the distribution of density within the earth

Dr E B Chain, university demonstrator in chemical pathology, University of Oxford, distinguished for his work on enzymes of snakevenom and bacteria, and especially for his researches on penicillin and other antibiotics

Dr U R Evans, reader in metallic corrosion, University of Cambridge, distinguished for his researches on metallic corrosion

Prof E D Hughes, professor of chemistry, University College, London, distinguished for his researches in the mechanism of the reactions of carbon compounds

Prof W Q Kennedy, professor of geology, University of Leeds, distinguished for his contributions to tectonic geology and petrogenesis

Prof. W B R King, Woodwardian professor of geology, University of Cambridge, distinguished for his researches on the Lower Palæozoic rocks and on Pleistocene deposits

Sir Ben Lockspeiser, chief scientist, Ministry of Supply, distinguished for his contributions to the development of modern aircraft

Dr J M McNeill, naval architect, John Brown and Co Ltd, Clydebank, distinguished for his contributions to naval architecture

Dr H R Marston, chief of the Division of Biochemistry and General Nutrition, Commonwealth Council for Scientific and Industrial Research (University of Adelaide, South Australia), distinguished for his researches on nutrition and woolgrowth in merino sheep and on trace element deficiency diseases in ruminants

Prof K Mather, professor of genetics, University of Birmingham, distinguished for his contributions to genetics and particularly for his studies of polygenic inheritance

Prof P B Medawar, Mason professor of zoology distinguished for his studies of growth process and the phenomena associated with tissue transplantation

Dr W T J Morgan, research worker, Lister Institute of Preventive Medicine and reader in biochemistry in the University of London, distinguished for his contributions to the chemistry of immunology and blood groups

N W Pirie, head of the Biochemical Department, Rothamsted Experimental Station, Harpenden, distinguished for his researches on the chemical and physical properties of plant viruses

Prof C F Powell, Melville Wills professor of physics, University of Bristol, distinguished for his contributions to experimental physics, especially for his work on the properties of mesons

Dr D A Scott, reasearch member, Connaught Laboratories, University of Toronto, distinguished for his contributions to the chemistry of insulin, heparin and carbonic anhydrase

Prof Wilson Smith, professor of bacteriology, University College Hospital Medical School, London, distinguished for his researches on the virus of influenza and on the pathology of staphylococcal infections

Dr G B B M Sutherland, reader in spectroscopy, Department of Colloid Science, University of Cambridge, distinguished for his experimental researches on infrared and Raman spectroscopy, especially of hydrocarbons

Prof O G Sutton, professor of mathematics and physics, Military College of Science, Shrivenham, distinguished for his researches in atmospheric turbulence and evaporation

Prof Meirion Thomas, professor of botany at King's College, Newcastle-upon-Tyne, distinguished for his researches in plant physiology, and particularly for his work on the breakdown of sugar in the plant.

Prof J M Whittaker, professor of mathematics, University of Liverpool, distinguished for his researches in the theory of integral functions

Prof F G Young, Professor of biochemistry, University College, London, distinguished for his studies of the role of the hormones of the anterior lobe of the pituitary gland in carbohydrate metabolism

(*Nature*, March 26, 1949)

TELEVISION SERVES SCIENCE

For the first time in Europe an audience of 200 medical practitioners and students has been able to follow an operation by television This was on the occasion of the anniversary of Holland's oldest university at Leiden Whilst an operation was being performed in the operating theatre of the hospital at Leiden, this was televised and projected, *via* cables, on two screens of 1 30 × 1 m set up in the lecture hall in another wing of the hospital

Philips Eindhoven, who undertook the technical arrangement of this unique experiment in television after the most painstaking preparations, produced for the benefit of the astonished audience a wonderful picture which demonstrated beyond all doubt the enormous possibilities of television as an aid to medical training

The Dutch newspapers, represented by their medical correspondents, expressed great satisfaction with this achievement of Dutch industry, whilst in some speeches given at the close of the demonstration representatives of the Leiden university spoke in terms of admiration about this further proof that also in the technical field Holland is recovering from the blows it suffered during the war

JOURNAL OF ZOOLOGICAL SOCIETY OF INDIA

The publication of a *Proceedings* by the Zoological Society of Bengal (see SCIENCE AND CULTURE, *13*, 496, 1948) is followed in quick succession by this *Journal of the Zoological Society of India* This is a healthy sign, as it obviously points out to the increase in the volume of research work and increase in the number of research workers in biological sciences in India The Zoological Society of India was founded in 1939 and the Society has now brought out its publication in the form of a biannual journal The first number (January 1949) of this journal contain 70 pages, with 26 text figures and one plate There are in all 11 research papers dealing with a wide variety of subjects Three of these are a series of contributions on the Nematodes of Ceylon by C A Loos, and the rest are on Zoogeography, Zoological standards and progress, Ichthyology, Embryology and Entomology

The editing is good, printing is fair but there is scope for improvement of the paper The price for this single issue fixed at Rs 10/- (inland) and Rs 11/- (foreign) is unfortunately not commensurate with the number of pages offered

The headquarters of the Society is in the office of the Zoological Survey of India, Indian Museum, Calcutta 13 The *President* for the current year is Dr S L Hora, *Secretary*, Major Dr M L Roonwal and *Editor*, Prof K N Bahl

We wish the Society and its Journal a prosperous career

G P MAJUMDAR

Professor Girija Prasanna Majumdar, who retired on February 17, 1949, from the Presidency College, Calcutta, and the Calcutta University after serving these institutions for 35 years, fostered with unusual interest the development of botanical studies in India and endeavoured to popularize science in the young minds by his writings in various scientific, literary and juvenile magazines By his researches and a series of publications, entitled, "*Upavana Vinoda*," an ancient text of Arborihorticulture, "*Vanaspati*," "*Some Aspect of Indian Civilization in Plant Perspective*," and "*Prachin Bharate Udvid Vidhya*" (in Bengali), he has shown to the world Ancient India's contributions to Botany which has now added a new chapter in the History of Plant Sciences For these investigations he received the *Griffith Memorial Prize* of the Calcutta University At the request of the Editor of the *Chronica Botanica*, U S A , he is writing a volume on the "History of Botany in India " Dr Majumdar has also specialized in the Developmental Anatomy of Plants and has contributed many valuable and critical studies on the subject in British and Indian journals He presided over the Botany section of the Indian Science Congress in 1945, when he addressed on Plant Anatomy in modern research Earlier, he was elected a Fellow of the National Institute of Sciences of India, in 1943 This year he has been elected *President* of the Indian Botanical Society and *Chief Editor* of its *Journal* He is also actively associated with Botanical Society of Bengal since its foundation and of which he is a past President

Speaking at a reception given in honour of Dr Majumdar, at the Presidency College, Calcutta on May 3 last Dr P Parija, Pro Vice Chancellor, Banaras Hindu University said that it was indeed a misfortune that we were going to lose the services of Dr Majumdar on the grounds of age only, when it is noted that men like His Excellency Sri C Rajagopalachari and Hon'ble Sardar Patel are able to hold responsible positions of the State India is suffering from a shortage of scientific manpower and there are not many specialists like Dr Majumdar It would be a national gain if his services could yet be utilized for the help he can render in botanical research to our young men and women

It is indeed gratifying to note that since then India's Prime Minister and Minister for Scientific Research Pandit Nehru stated in the Constitutent Assembly of India on May 24 last that when absolutely first class persons were needed for certain important posts it would be a dangerous thing to fix an age limit Eins-

tein was certainly very much over 60 but he remained the greatest scientist of the age

India was short enough in first class scientists and it would be a calamity for her not to utilize their services because of some rule fixed for some administrative services which had nothing to do with high class inventive brain work Pandit Nehru added that the question of fixing an age limit for Ministership is worthy of consideration by the Assembly

ANNOUNCEMENTS

Dr H L Chakravarty, Lecturer in Botany, Presidency College, has succeeded Dr G P Majumdar as Professor in that College Dr Chakravarty recently returned from U K, where he worked on the "Systematics of Indian Cucurbitaceæ" and on "The floral morphology of the Cucurbitaceæ"

Dr B B Mundkur, Deputy Director, Directorate of Plant Protection, Government of India and Dr D Chatterjee, until recently botanist for India at Kew have been elected members of a Special Committee of the International Botanical Congress to be held at Stockholm in 1950, to consider proposals to modify the existing International rules of botanical nomenclature

Dr Dudley Stamp, Professor of Geography, London School of Economics has been awarded the Founders Medal of the Royal Geographical Society for the year 1949, for his work in organizing and directing Land Utilization Survey of Great Britain and his application of geography to national planning

The following Research Fellowships have been awarded by the National Institute of Sciences of India for the year 1949-50

National Institute of Sciences Senior Research Fellowship

Mr U R Burman, M Sc (Cal), to work on "Internal Constitution of Stars" at the University of Calcutta

Dr A B Kar, Ph D (Edin), to work on "Endocrinology with special reference to Birds" at the Central Drugs Laboratory, Calcutta

Dr S M Mukherji, D Sc (Cal), Ph D (Bir), to work on "Use of metal ammonia reduction method in the synthesis of naturally occurring substances and valuable intermediates" at the University of Calcutta

Dr K V Srinath, Ph D (Lond), to work on "Cytology" at the Central College, Bangalore

National Institute of Sciences Junior Research Fellowship

Miss Ira Bose, M Sc (Cal), to work on "Effect of Ionizing Radiations on Grasshopper chromosomes" at the University of Calcutta

Mr S Datta Majumdar, M Sc (Cal), to work on "Relativity and Quantum Mechanics" at the University of Calcutta

Dr S G Joshi, Ph D (Bom), to work on "Mineral Nutrition of Plants and Microbial and Biochemical activities in the Soil" at the Fergusson College, Poona

Mr T M Mahadevan, M A (Mad), to work on 'Rare Minerals of Madras Presidency—a study" at the Presidency College, Madras

Mr D K Mukherji, Dip Agri (Cantab), to work on "Plant Physiology as applied to Plant Breeding (Embryo culture)' at the Indian Agricultural Research Institute, New Delhi

Mr K Subramanyam, M Sc (Mysore), to work on 'Embryology and Floral Anatomy in some members of *Melastomaceae* and Embryology of *Lobeliaceae*, *Campanulaceae* and *Stylodiaceae* with a note on the interrelationship of these families at the Central College, Bangalore

Mr B V Sukhatme, M A (Delhi), to work on the 'Theory of certain distribution in non parametric tests and its applications' at the Indian Council of Agricultural Research, New Delhi

Imperial Chemical Industries (India) Research Fellowship

Mr A K Chakravarti, M Sc (Cal), to work on "Cytogenetics on some common fruit trees of India and the application of colchicine to raise improved types" at the University of Calcutta

Dr A P Mahadevan, Ph D (Lond), to work on "studies in the Pterin Field" at the University of Madras

Mr C Ramasastry M Sc (Mad), to work on "Spectroscopy" at the Andhra University

Dr K K Reddi, Ph D (Mad) to work on "Role of anti thiamine factor in Nutrition" at the Indian Institute of Science, Bangalore

ERRATA

In page 482 of May 1949 issue, 2nd column, in the equation *read* $\frac{4\pi N\mu^2}{KT}$ *for* $\frac{4\pi Nb^2}{KT}$ and in the table *read* $h\times10^{18}$ *for* 6 10^{18} and 0 0 *for* 2 58 against δ Isomer Dioxane

BOOK REVIEWS

Report of the Committee on Indigenous Systems of Medicine Vol I—Report and Recommendations, pp 200, Vol II—Appendices pp 550, 1948 Published by the Ministry of Health, Government of India

The Ministry of Health of the Government of India has published the report and recommendations of the Chopra Committee,—a long and exhaustive report of 200 pages It took quite a long time for the Committee to submit its Report and in Chapter III, the Committee has described its progress of work, rather we should say the causes of delay of the work The Report begins with the history and development of the *Ayurveda*, gives a resume of the work of previous Committees on indigenous systems of medicine set up by provincial and other Governments, describes the present state of indigenous systems of medicine, its practitioners, institutions of teaching and medical relief

Medical relief provided in India by the Western system of medicine is extremely limited There seems to be one qualified doctor to attend to every 6300 people This, of course, is in great contrast to one doctor for every 1000 of population in the United Kingdom Out of 47,524 doctors available in the undivided India in 1941, only about 13,000 are reported to be on the staff of the medical institutions maintained by the Governments and other agencies Indigenous medicine is still largely practised in India The Report says that the present state of the indigenous systems is far from being satisfactory The practitioners in most cases are ill trained and their institutions of education and relief are ill equipped, ill housed and poorly staffed Even then the indigenous medicine has more than the familiarity of the public for the cheapness of the drugs and the sympathetic treatment of the practitioners The Chopra Committee does not believe that there can be separate systems of Western or Indian medicine It suggests a synthesis of the indigenous and Western systems For Indian medicine can adopt the more useful and developed science of modern surgery, obstetrics, structural physiology and pathology This suggestion has led to much controversy and differences of opinion amongst the *Ayurvedacharyas* The Committee thinks that the blending of Indian and Western systems of medicine is practicable and recommends that immediate step is to make a comparative study of the Indian and Western medicine For example, *Sharira* of the *Ayurveda* can be taught with Anatomy of modern medicine, *Striroga* with Gynaecology, *Kaya Chikitsa* with Medicine and so on The second step is to teach each pair of subject by the same teacher, who will give the students a unified view of both Western and Indian medicine The last step will result from the findings of the Research Institute on both the systems

"It is essential," the Report says, "that each College of Indian medicine should, in addition to its teaching work, provide for post graduate studies and research " The Report has devoted one full chapter to the aims and approach to research on indigenous medicine, and Col Chopra, the Chairman of the Committee is a past master in this subject The Committee suggests that research should be conducted on the following subjects

(1) In fundamental doctrines of the *Ayurveda* including *Siddha* and Unani Tibbi systems, (2) Literary research, (3) Clinical Research, (4) Pharmacological research, (5) Research in Dietetices, and (6) Research in Psychological aspects of Indian medicine

These obviously are good suggestions, and call for solid team work Both clinical and pharmacological researches on indigenous drugs have been attempted by the Indigenous Drugs Enquiry with Colonel Chopra as the guide These fields of research are quite vast and researches in these lines are far from complete, for the obvious reasons which the Report states, as many of the plants mentioned in the *Ayurveda* are not described adequately and are difficult to recognise An authentic sample of a drug is difficult to obtain from the indigenous drugs sellers The pharmacognostical researches on the indigenous drugs is badly needed A central herbarium of the medicinal plants is indispensable Properly identified specimens of all known medicinal plants are really difficult te obtain The nomenclature of medicinal plants needs a revision, and type specimens of the species are to be preserved in the herbarium This kind of work requires survey and cultivation as well as chemical analysis of medicinal plants

The Report has not overlooked the standardisation of medicinal preparations and building up of a Pharmacopoeia of Indian medicine It may not be possible at the moment to prepare a Pharmacopoeia of Indian medicine on the lines of Western medicine The Report says that it may however, be possible to prepare a Pharmacopoeial List on the lines of the Indian Pharmacopoeial List, 1946, which the Report adds, was prepared by an Expert Committee under the Ministry of Health " We beg to say that the Expert Committee was not expert enough to compile it for they could not stop the errors that had crept in the List Some of the errors we had already pointed out in the last month in our journal We hope the revised list will be a more reliable one We have mentioned only the most fundamental part of research on indigenous drugs, and we hope that the recommendations of the Committee will be given effect soon

R. G. C.

When the Earth Quakes—By J B Macelwane, S J, Ph D The Bruce Publishing Company, 540 N Milwaukee Street, Milwaukee 1, Wisconsin, U S A xi + 288 pp Price $5 00

This book is one of the Science and Culture Series issued under the general editorship of Rev Joseph Husslein, S J, Ph D of St Louis University The author Rev J Macelwane, is himself a distinguished Seismologist, being the dean of The Inst of Geophysical Technology, St Louis University, U S A

Seismology, as understood today, is a science combining physical geology with mathematics The reader who therefore expects to find mathematical expositions of the laws of elasticity as applied to seismic science will be disappointed, as there is not a single mathematical expression in the whole text He has then to turn to other advanced publications on the subject, the most recent of them, being Dr Perry Byerly's "Seismology" (Prentice Hall, 1942) In spite of this omission it is gratifying to learn that the presentation of this subject is carried out thoroughly and in a very interesting manner The first six chapters deal with the description of earthquakes and their effects on living beings, types of disturbances, (*viz* tectonic, plutonic and volcanic) and their primary causes, and field studies for mapping isoseismal and coseismal lines Chapters 7, 8 and 17 deal with seaquakes, seismic sea waves and microseisms, while the general principles, types and uses of seismographs are discussed in chapters 9 to 11 The engineering aspects of this science are dealt with in chapters 12 and 13 and the study of the industrial problems that arise from man made vibrations termed "Seismological Engineering," such as quarry blasts, triphammer blows, and road and rail traffic are relegated to chapter 14 Chapter 15 deals with rock bursts and overstrain, and Chapter 16 with the method of seismographic prospecting In describing the field of engineering seismology, the author has unfortunately not given a full share of importance to the work of Japanese school led by such distinguished scientists as Suyehiro and Naito As the reviewer pointed out in a previous paper, ("Developments in Engineering Seismology," SCIENCE & CULTURE, Feb 1948, pp 312 320), the major discussions on the seismic design of structures which took place at the World Engineering Congress at Tokyo as far back as 1929, revealed the fact that Japanese work on the subject was far in advance of any other country and the world of engineering seismology had to accept that country's work as representing the most authoritative and latest thought of the times In the bibliography at the end, the author has not even referred to the set of excellent lectures and papers contributed by Dr Suyehiro at the Stanford & California Universities and other institutes, which produced a profound modification in the then current trend of American structural design

As the book does not aim to deal with the mathematical aspect, it can be understood that a full treatment of the new conception of earthquake spectrum need not be given However, a brief description of this idea as put forward in its refined form by Prof Biot should have been included in the text Many informative ideas are revealed by this spectrum, the most interesting being the "whip" effect so conspicuously noticeable on penthouses and the tips of tapered columns and buildings

In Appendix A, a digress of actions of various geological agents is given together with a "geological time table" In this table, the folding period of "Sierra Nevada" is incorrectly shown in the Triassic instead of the Jurassic period, and the position of the "Rocky Mountains" appears too low in the scale Typographical errors are rare except those on page 26 wherein San Andreas Rift is once wrongly spelt as San Andre's Rift, and on page 109, in fig 111 "crustal blocks" mis spelt as "crystal blocks"

Practically the entire field of elementary seismology covering physical, geological and engineering aspects are lucidly surveyed in this text, with good photographs, enabling a non technical reader to grasp the fundamentals of this science

S K G

Text Book of the Materials of Engineering—By Herbert F Moore, McGraw Hill Book Co Inc, London and New York Cloth 6" × 9", pp x + 500, Seventh edition, 1947, Price $ 5 00.

This seventh edition of the text under review was first published in 1917, and contains many additions and modifications to cover practically the entire range of metallic and non metallic materials subjected to stress The vast amount of exact information given on the properties of engineering materials together with other relevant data on the designing, testing and processing methods, render this volume a formidable work of reference and a valuable guide for engineers

There are in all 22 chapters and an Appendix The first seven chapters introduce the reader to the fundamentals of elastic behaviour, stress, and strain, creep, fracture, working stresses, safety factors and the selection of materials Chapter 8 deals with the crystalline structure of metals and is written by Prof Draffin, of the University of Illinois In discussing this subject, the author reviews the basic ideas on the formation of crystals from the original study made by Sorbey in 1864 to the present X ray and microscopic analysis The next six chapters cover the production of common structural metals, and their heat treatment and control Tables of strength, ductility and notch-toughness of typical non metals and a wide variety of steels is also included In the next six chapters the role of wood, stone, brick, cementing materials, concrete, plastics, rubber, leather and rope is given The chapter on "Concrete" is written by H F Gonnerman, Director of Research, Portland Cement Assoc., Chicago, and on "Plastics" by Prof W N. Findley of the

University of Illinois Though necessarily not exhaustive, the data furnished in these sections is quite accurate, and compact, to serve the preliminary needs of a designing engineer in search of selection of materials The last two chapters deal with the testing, inspection and specifications of materials Selected references for further study are included at the end of each chapter, with a conspicuously striking note after the first one Herein, Rudyard Kipling's "The Day's Work", (Doubleday and McClure Co, New York) is included as a reference for further study The reviewer believes that only an engineer of the eminence of Dr Moore could have ever thought of linking one of the stories in this Kipling's work (*viz* "Bread Upon Waters") as a note outlining the modern theory of the fatigue of metals The profound depth of the author's vision and the immense width of his knowledge are clearly brought to light in this unique reference

Among the various load bearing engineering materials mention may be made of titanium as one of the "future" metals Titanium is the fourth most abundant structural metal in the earth's crust ranking after aluminium, iron and magnesium Since 1930 work in the U S Bureau of Mines has revealed the fact that this metal has mechanical properties akin to medium carbon steels and corrosion resistance as good as stainless steels Besides it can be fabricated into sheet, bar, and wire by normal methods and can be produced at a price relatively high but not altogether prohibitive The developments in aircraft design have also led to the growth of a new class of light weight composite engineering materials which appear to have very wide potentialities These are the so called "Sandwich" materials consisting of two thin layers of high strength facings like aluminium alloys bonded to a thick layer of low density core such as wood The core which provides shear connections between the facings, increases the effective moment of inertia of the facing cross section and thus makes possible a considerable improvement in the stability of structural members without in any way increasing the overall weight The inclusion of a descriptive outline of these new materials would have further enhanced the text In the chapter on "Concrete" a description is given of vibrated concrete, but no mention is made of "prestressed concrete", which is one of the newer forms of obtaining crack-free, and very high strength-resistant products The appendix includes some formulas in common use for determining stresses, a set of descriptive, non mathematical questions, and a list of visual aids, giving the names of films and filmstrips available in local libraries and universities This list vividly points out the magnificient facilities afforded by American Universities to its students as compared with the niggardly facilities offered by the largest universities of this country and to a certain extent by English and European institutions also

Taken as a whole, this text written by an Emeritus Research Professor of Engineering Materials, University of Illinois, and doyen of the profession, forms an authoritative source of reference on a wide range of engineering materials, and should find a place on the bookshelves of practically all classes of engineers

S K G

A Catalogue of Insecticides and Fungicides—Compiled by Donand E H Frear, Ph D, Volume I, Chemical Insecticides, 1947, Pp 203, $6 5 Volume II, Chemical Fungicides and Plant Insecticides, 1948, Pp 153, $5 5 Published by Waltham, Mass The Chronica Botanica Co, Calcutta, Bombay, Madras Macmillan & Co Ltd

It has been estimated that five per cent of the world's food production is lost due to insects With 'grow more food' campaign goes the drive 'kill more insects' Control of insect food pests and also the control of disease bearing insects, particularly in the tropical countries are of extreme importance Researches in this field drew the attention of chemists, physiologists, entomologists and botanists for during the last World War II there was threatening food shortage throughout the world Some promising chemical insecticides like D D T, Chloranil, etc have already been discovered, more are on their way to discovery Insecticides from plant sources have already come out, rotenone and pyrethrin are worth mentioning For a thorough and systematic investigation on insecticides, their chemistry, manufacture, killing properties, effect on human beings etc, a team work is obviously needed, specially (*a*) "to make a thorough search of the published literature on the subject, and (*b*) "to correlate the results of these tests with chemical and physical properties of the materials used" to find out the nature of the toxic action

The present catalogue is of primary importance for the research workers in the field of insecticides, and thanks are due to the efforts of Dr Donald E H Frear who has left no stone unturned to make the catalogue as complete as practicable

R G C

An Introduction to Pakistan its Resources and Potentialities—by Maneck B Pithawalla, Karachi, 1948, Price Rs 5/-

This is an interesting booklet which merits the attention of those who want to know about the newly born State Dr Pithawalla presents within a brief compass the history of the partition of India and also how Pakistan came into being Then he introduces the character of the land and also the present state of its economic development He has also given his own impressions about the potentialities of the State geographically considered

We would however plead that in subsequent editions the author would provide better and more

accurate maps The map in Plate V, for example gives one the impression that the eastern part of the district of Murshidabad is in Pakistan We would also suggest that the Chapters on economic resources should be more developed so that the treatment for all chapters may be more uniform

K G B

Excavations in Mayurbhanj—By Nirmal Kumar Bose and Dharani Sen, University of Calcutta, 1948 Price Rs 7/

This is a report of excavation work carried out in Mayurbhanj by the Anthropology Department, Calcutta University Besides it contains a systematic study illustrated with Lucida sketches of the stone implements found in the area and their classification A number of problems have been raised in the book which may be solved in course of subsequent investigations if carried out One such is with regard to the dating of the laterites and the gravel beds in which the implements are found There is unmistakable evidence at least in one site of the laterite being of primary formation Climatically and petrologically most areas in Chota Nagpur are suitable for laterisation and this is in progress even now Hence the dating of this formation would involve detailed geochronological investigations—a task big in itself

Another problem that has been raised is with regard to the homotaxiality of Mayurbhanj (Kuliana) culture with similar cultures elsewhere

Messrs Bose and Sen deserve praise for the detailed precise and systematic work that they have put in and the various problems they have raised, for the solution of which they have also made a number of useful suggestions

K G B

Crystals and X rays—By Kathleen Lonsdale, D Sc, F R S, Pp viii + 199, 13 plates (G Bell and Sons Ltd York House, Portugal Street, London W C 2) Price 21s net

It is mentioned in the foreward that this book is based on a course of public lectures given at the University College of Science, London during 1946 and is not intended to be a text book of X-ray crystallography A careful persual of the book, however, shows that the principles of all the methods of X ray analysis of crystals have been explained in it and the book will therefore be much useful to those research workers who are engaged in this line of research Starting with a historical introduction in chapter I in which the discovery of Laue diffraction patterns, Bragg reflections and Moseley's work on X ray spectra of elements have been mentioned, the method of generation of X rays and the nature of continuous and line X-ray spectra have been discussed in Chapter II In next chapter the symmetry exhibited by natural faces of crystal has been explained with the help of diagrams and diagrammatic representations of the 32 classes of crystals have been included The internal symmetry of these classes has also been explained with the help of diagram of Bravais space lattices and a few space groups Chapter IV deals with the methods of determination of geometrical structure in crystals, involving application of the ideas of reciprocal lattice The use of Berral's chart for finding out the indices of planes giving reflections in a rotation photograph and the method of determination of space groups in crystals have also been discussed in this Chapter The methods of determining atomic and electronic distribution in the unit cell of crystals of different classes have been given in Chapter V Diagrams of Fourier projections of a few crystals have been reproduced in this chapter In the next chapter some topics under the heading 'extra structural studies' have been discussed These include among other things divergent X ray beam photography and diffuse spots in Laue photographs of imperfect crystals In the remaining chapter dealing with the importance of the study of crystals it has been pointed out how it is possible to get information regarding the internal structure of crystals, metals and alloys, fibres, etc, from results of X ray analysis

In all the plates the original photograph have been reproduced with precision The get-up of the book is very good Considering the number of line and halftone blocks used, the price seems to be reasonable and it can safely be predicted that the book will find its place in the libraries of almost all the universities and research institutions interested in this subject

S C S

LETTERS TO THE EDITOR

[The Editors are not responsible for the views expressed in the letters]

A NEW METHOD FOR THE ESTIMATION OF COPPER AND ZINC IN BRASS

Although largely employed as a tool for study of reactions in solution comparatively few applications have been made of Dutoit's Thermometry[1] in quantitative analysis upto the present day

In the following the author has presented a method for estimating copper and zinc in brass based on thermometric titrations which appears promising as a rapid method for industrial analysis of the alloy

The principle underlying the method consists in titrating total copper and zinc at a suitable $P_H(4\ 0)$ thermometrically with standard $(NH_4)_2\ Hg\ (SCN)_4$ In an aliquot part Cu is precipitated as $Cu_2\ (SCN)_2$ after reduction with sulphur dioxide and after settling for sometime Zinc is titrated with the same standard solution The difference in the two titre values gives copper The presence of Pb, Sn or Fe in the solution does not interfere, since these are not precipitated by the above reagent under the condition of titration

My grateful thanks are due to Prof P B Sarkar for kindly suggesting the problem and giving full facilities for carrying out the work in his laboratory.

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[1] Dutoit & Grobet, *Town da chim Physique 19*, 324, 1922.

INSECTICIDAL PROPERTIES OF HEXACHLOROCYCLOHEXANES, DDT AND RELATED COMPOUNDS

Insecticidal properties of hexachlorocyclohexanes and DDT have formed the subject of numerous investigations Toxicity of these compounds have been measured as percentage mortality for certain concentration and time by a number of investigators (c f [4,5]) It was observed that the relative concentration required to cause equal mortality was different at different mortality levels and the toxicity of these compounds was not proportional to the time and concentration of the toxic insecticide

Dosage of toxic materials sufficient to ensure complete mortality of insects cannot be determined very precisely because of the S shaped curve between the dosage and the mortality

Number of estimates of relative toxicity were made by applying various equations like $k_6\, x^n = \frac{y}{100-y}$ (Langmuir 1934, c f [2]) $x = k + kx \log\frac{y}{100-y}$, where x and y are the dosage and mortality and k, k, n etc, same constants, the calculated values were still distributed in a sigmoid manner

Bliss[1] has suggested the Probit method in which the mortality in probits (probability integral of mortality) is plotted against logarithm of the concentration of the drug, and a linear graph is obtained This method of probit analysis has been developed and applied by Finney[3] to large number of organisms

Way *et al*[6] have applied this method in their study on the effect of DDT and hexachlorocyclohexane on honey bees

The Probit method involves introduction of the arbitrary constants and does not give any quantitative idea about the relative toxicity

We have applied the law of mass action $k = k_{c/c} = \frac{2\ 3}{t} \log \frac{100}{100-x}$ where x is the number of insects killed in time t and k_c is the mortality coefficient at concentration c, k_c being directly proportional to the concentration c Following tables give the results of such calculations for mosquito larvae in the case of hexachlorocyclohexane isomers and DDT and related compounds

TABLE 1

TOXICITY OF HEXACHOLOROCYCLOHEXANE ISOMERS TO MOSQUITO LARVAE

Isomer	Dosage P P M	Percentage 24 hrs	Mortality 48 hrs	Mortality Coefficient k	Moment $h \times 10^{14}$
α	2 5	88 Kc(0 088)	92 0 053	0 028	1 7
β	100 0	22 Kc(0 013)	40 0 016	0 0001	0 0
γ	0 01	88 (0 067)	100	6 700	2 55
δ	2 5	40 (0 021)	62 0 020	0 008	0 0

TABLE II

TOXICITY OF DDT ISOMERS TO MOSQUITO LARVAE (a)

o,p DDT	0 010	35 Kc 0 018	45 0 015	1 6	1 9
m,p′ DDT	0 02	73 Kc 0 054	98 0 082	2 6	1 5
	0 01	33 Kc 0 015	77 0 021		
p,p′ DDT	0 005	83 Kc 0 073	97 0 074	14 6	1 1
	0 0025	55 Kc 0 033	82 0 036		

(a) Data from Haller[4]

Table 1 shows that the mortality coefficient K_c of hexachlorocyclohexane isomers at concentration C (Col 3) is practically independent of time The mean mortality coefficient K (Col 5) shows that γ is 240 times as active as α and 840 times as active as δ, β isomer having practically no activity Table II shows the toxicity pp′ DDT and its isomers to mosquito larvae The constancy of K irrespective of time and concen tration is borne out by the results obtained for pp′ DDT and isomers

Full paper will be published elsewhere

S K KULKARNI JATKAR
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1 Bliss C I, *Science*, *79*, 38, 1934
2 Bliss C I, *Ann Appl, Biol*, *22*, 134, 1935
3 Finney D J, *Ann Appl Biol*, *31*, 68, 1944
4 Haller, *Indust Eng Chem* *67*, 1591, 1947
5 Slade, *Chemistry & Industry* *64*, 314, 1945
6 Way M J and Sygne A D, *Ann Appl Biol*, *35*, 94, 1948

EFFECT OF BOILED RICE PREDIGESTED WITH *ASPERGILLUS ORYZAE* ON THE GROWTH OF MICE

Pre-digested foods are more and more occupying an important place in human nutrition Peptonised milk, Protein hydrolysates, Yeast autolysate such as marmite are all being used in increasing quantities against various disorders of the alimentary and other systems Pre digestion of food, if properly made, may help to serve the maximum quantity of nutritional elements in a small volume, and thereby eliminate wastage in food

During an investigation on malt formation from various cereals, in this laboratory, boiled rice was subjected to enzymatic hydrolysis by *Aspergillus oryzae* In order to see whether the material so digested could serve as a ready food for animals, certain experiments were carried on mice growth The sample taken for growth studies was a quantity of boiled rice inoculated with a stock strain of *Aspergillus Oryae* and growing for 3 4 days The fungus was subsequently destroyed by heating the mass, and the dried preparation, there after, was found on analysis to be of the composition

Moisture 4 88%, Total solids 64 7%, Protein 8 26% Formol N_2 0 0843%, Reducing sugars in terms of glucose 28 73%, Acid hydrolysable saccharides (calculated as glucose) 52 73%, Acidity as lactic acid 2 43%

Two groups of weaned in bred mice from the same litters were kept in individual cages for study All weights were taken under a uniform condition of three hours' fasting in the morning The distribution of mice in two groups was done away as to make the total weights in both remain the same The first group was fed daily with the pre-digested boiled rice material, and the second group was kept on a stock diet, consisting of crushed barley, wheat bran, and bread Cod Liver Oil was given in equal dosage to both the groups twice a week Some greens such as fine twigs were served to all of them Individual as well as group weights

TABLE I

GROUP I—FED WITH BOILED RICE DIGESTED WITH *Aspergillus oryzae* (D F)

Mouse No	Weight before experimental feeding (gms)	Total group weight (gms)	Bi weekly weight after feeding of D F								Remarks
			*I	†T	I	T	I	T	I	T	
1	13		13		12		10		D		
2	13	74	11	65	11	63	10	54	7	7	§D on the 15th day
3	13		11		11		9		D		
4	12		11		10		8		D		
5	12		10		10		9		D		
6	11		9		9		8		D		
GROUP II –STOCK DIET											
7	13		15		19		20		21		
8	13	74	15	83	17	102	19	111	20	118	Growth normal No mortality
9	13		14		18		19		21		
10	12		13		16		19		21		
11	12		14		16		17		18		
12	11		12		16		17		17		

* I = Individual weight †T = Group weight §D = Death

were recorded bi-weekly The observation period was two weeks Table I shows the results of these studies

From the results of the experiments it is evident that boiled rice, predigested under enzymic hydrolysis by *Aspergillus Oryzae* is unable to serve as a complete food for mice On the contrary, it appears, from the rapidity of the onset of death in Group I (fed with this material), that there must be some toxic factor associated with the food

A N Bose

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STUDIES IN THE CATALYTIC PRODUCTION OF BUTADIENE FROM ETHANOL, PART III

During the course of their investigations on the catalytic production of butadiene from ethanol and acetaldehyde, Toussaint *et al*[1] found that the conversion increased with the incorporation of columbium, or zirconium or tantalum in the catalyst, with increasing order of efficiency Studies were undertaken here to investigate the possibility of utilisation of zirconium oxide as one of the dehydrating components in the catalyst for the one-step conversion of ethanol to butadiene The effect of temperature over the yields of various products was studied and the results tabulated in Table I These results are compared in Table II with those obtained, under similar conditions, with catalyst II [2]

For the same space velocity, the yield of butadiene (on ethanol converted) is much higher with catalyst II than with catalyst III containing zirconium oxide But the process yield of butadiene (on ethanol fed) is more or less the same in both the cases and increases with a rise in temperature The ethanol-conversion efficiency is much higher for catalyst III than for catalyst II

Investigations are in progress regarding the study of other space velocities over the yield of butadiene with catalysts I, II and III and the results will be communicated later

The components of catalyst III *viz*, magnesium oxide silica zirconium oxide were taken in the ratio 51 2 20 5 respectively To a solution of sodium silicate was added nitric acid to form silica gel Solutions of zirconium nitrate and magnesium nitrate were added in required amounts to the gel followed by ammonium hydroxide to co precipitate the respective hydroxides over silica The precipitate thus obtained was filtered and the filtrate digested with sodium hydroxide to pre cipitate the zirconium still in solution The precipitate was added to the impregnated gel, the mixture filtered, washed and dried and powdered to 100 mesh The powder was activated for 36 hours at 360° 375°C Water was added to the powder thus obtained and the catalyst caked out on a Buchner When semi dry pellets of the size 6 7 to an inch were formed and dried in an oven for 24 hours at 100°C The catalyst tube was charged with 65g of the catalyst

TABLE 1

	Data for Catalyst III	Temperature 400°C	425°C	450°C	475°C
1	Ethanol feed stock, abs alcohol distilled over calcium	50 cc	50 cc	50 cc	50 cc
2	Ethanol returned %	43 37	25 91	15 24	3 26
3	Ethanol converted—(by difference) %	56 63	74 09	84 76	96 74
4	Rate of feed of Ethanol cc /hr /g of catalyst	0 769	0 769	0 769	0 769
5	Gas collected in litres, at N T P	7 00	13 22	14 94	17 88
6	Composition of gas (by volume)				
	Unsaturated hydrocarbons	43 46	44 89	42 79	41 13
	Hydrogen	34 17	30 39	37.46	40 61
	Carbon monoxide	1 51	4.13	2 98	2 05
	Saturated hydrocarbons	7 79	5 58	7 96	5 91
7	Butadiene content of gas g/l	0 5613	0 5102	0 4530	0 4229
8	Yield of products expressed as % by wt of absolute alcohol converted				
	Hydrogen	0 97	1 24	1 51	1 72
	Butadiene	17 68	23 17	20 32	19 91
9	Production of Butadiene on the basis of the theoretical yield	30 14	39 49	34 63	33 92

TABLE II

Catalyst	Butadiene production on EtOH converted % at various temps 400°C	425°C	450°C	475°C	Butadiene production on EtOH fed, % at various temps 400°C	425°C	450°C	475°C
Catalyst II	7 12	34 40	33 44	34.34	1 47	17 80	17 51	21 73
Catalyst III	17 68	23 17	20 32	19 91	10 01	17 17	17 23	19 26

Our thanks are due to Sir J C Ghosh and to Prof B Sanjiva Rao for their keen interest in this work

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G D Hazra

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Bangalore 12 3 1949

[1] Toussaint W J, Dunn J T and Jackson D R, *Ind Eng Chem* *39*, 120, 1947

[2] Srinivasan R, and Hazra G D, "Studies in the catalytic production of Butadiene from Ethanol" part 1, Science and Culture, *14*, 436, 1949

AGE OF CASSAVA PLANT FOR MAXIMUM YIELD

In an earlier note[1] the average yield for a cassava plant has been discussed Cassava is not a seasonal crop and can be kept in the field for more than a year or even for years together without any appreciable outward symptom of aging or decaying The present note is an effort to estimate the age of Cassava plant that will give the maximum yield

As stated in the earlier note the more stable criterion for yield would be the quantity of finished produce obtained from the roots as the yield of raw roots would be very appreciably affected by the moisture content which varies from season to season

Random samples of Cassava plants were taken from Cassava plants of various ages and the total produce (Arrowroot, flour and *Suji*) obtained from each plant was measured The quantity of produce (in *chattaks*) obtained from each of the 10 plants of a particular age, for ages from 6 months to 14 months is shown in Table I

The analysis of variance of the data in Table I gives the following results (Table II)

Table II

Nature of variability	No of degree of freedom	Sum of squares	Mean square $=\sigma^2$ (Variance)	$\log_e \sigma^2$
Within array	63	847 61	13 45	2 59830
Between arrays	6	599 4	99 9	4 60301

difference = 2 0046, and Z = 1 0023

For $n_1 = 6$ and $n_2 = 63$, even at 1 p c level, the above value of Z is highly significant indicating a relationship between age and yield of produce from Cassava plant

By the usual least square method the following relationship may be easily derived for the region from 6 months to 14 months

$$y = - 29\ 568 + 8\ 261x - 0\ 3856x^2$$

where y is the average yield per plant and x is the age in months

The actual and estimated values of yield (as obtained from the above equation of relationship) are given below

Table III

Age of plant in months	Average yield of produce per plant	
	Actual	Estimated
6	7 15	6 11
7	7 80	9 36
8	11 80	11 84
9	14 75	13 55
10	14 15	14 48
12	14 60	14 04
14	12 20	12 68

The age of maximum yield can be found by differentiating the equation and then equating the result to zero Thus,

$$\frac{dy}{dx} = 8\ 261 - 2x\ 3856x = 0$$

$$\text{or } x = \frac{8\ 261}{2x\ 3856} = 10\ 7$$

Table I

	6 m	*7 m*	*8 m*	*9 m*	*10 m*	*12 m*	*14 m*	
	7 5	13 5	11 5	15	17 5	13 5	8	
	9	7	7	17 5	15	15 5	13 5	
	6 5	6 5	7	11 5	17 5	27	13 5	
	7	7	11	12	18 5	21 5	15 5	
	6 5	6 5	11	19	10 5	8	6	
	8	8	11	15	10 5	8 5	9	
	8	5	19	8 5	13 5	14	14	
	7	12 5	11 5	17 5	11 5	15	15	
	6	5	9	19 5	13 5	14 5	16 5	
	6	7	16	12	13 5	8	11	
Average—	7 15	7 80	11 40	14 75	14 15	14 60	12 20	(overall (average = 11 72)

Therefore, the age for maximum yield for a plant is 10 7 months, or say, between 10 and 11 months Thus the produce would be available once a year and during the one month or so, cultivation for the next season can be made

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TAMARIND (*TAMARINDUS INDICA*) SEED AS PROTEIN RICH FEED FOR LIVESTOCK

It has been pointed out by Kehar[8] as also by Ware[1] and Williamson[2] that the supply of livestock feeds from all organized sources even under normal conditions falls considerably short of the requirements According to a recent estimate the available supply of digestible crude protein is 40 per cent, and that of starch equivalent 41 per cent, of the required amounts Since four fifth of the cultivated land depends upon successful monsoon for crop production, the regularity of which, in a tropical country, can hardly be assured, this shortage of fodder is further keenly felt, when there is a partial or total failure of monsoon In previous publications Kehar[4], Kehar and Chanda[5], Kehar and Chanda[6], Kehar and Sahai[7], Kehar[8], have shown that some of the materials *viz*, *Saccharum munj*, Mango seed kernel, entrails, Jaman seeds and *Saccharum spontaneum*, which at present are considered as wastes, or are not economically utilized, could be used with advantage for feeding livestock after certain amount of processing These investigations have made available for exploitation, a large amount of animal feeds Observations on the use of tamarind seed as feed for cattle are reported in this note

Tamarind seed, the entire produce of which has not been till now economically utilized, was chemically analyzed and the results along with the analysis of a few commonly known grains are shown in table I

It will thus be observed that tamarind seed is richer in crude protein than barley, oats and maize except gram Its value for total carbohydrates compares favourably with oats and gram The CaO content of tamarind seed is higher and P_2O_5 content is invariably lower, as compared to other grains in the list

Feeding trials with tamarind seeds were conducted on two groups of Kumauni bullocks, each group consisting of three animals In group 1 tamarind seeds constituted the entire concentrate, whereas, in group 2 approximately 50 per cent of the protein requirement only was met from tamarind seed, the remainder being supplied by rape cake Wheat *bhoosa* was fed *adlib* in both the groups Common salt at the rate of 1 oz per animal was provided daily The feeding was continued for a period of six months in case of group 1 and for five months in the case of group 2 During this prolonged period of feeding no adverse symptoms were observed On the other hand, the animals in both the groups developed a fine bloom and added on an average, over the initial weight, 17 lbs in case of group 1 and 41 lbs in case of group 2 where 50 per cent of the required protein was supplied by tamarind seed

During the last 10 days of the feeding experiment, a metabolism trial was conducted on animals in both groups The average digestibility co efficients were found to be, crude protein 34 64, ether extract 85 25, crude fibre 48 15 and nitrogen-free extract 62 67 for the group with tamarind seed as the entire concentrate, and crude protein 28 03, ether extract 84 08, crude fibre 43 85 and nitrogen-free extract 55 86 for group 2 According to the two feeding methods the nutrients per 100 lbs of tamarind seed (dry basis) were found to be digestible crude protein 5 335, total digestible nutrients 60 142 and starch equivalent 50 122 for group 1 (tamarind seed as entire concentrate), and digestible crude protein 4 317, total digestible nutrients 53 956 and starch equivalent 50 004 for group 2

TABLE I

CHEMICAL COMPOSITION OF TAMARIND SEED AS COMPARED WITH SOME COMMON GRAINS

Name of Feeds	Crude Protein	Ether Extract	Crude Fibre	Nitrogen-free Extract	Total Carbo hydrates	Total Ash	Calcium (CaO)	Phosphorus P_2O_5
Tamarind	15 4	3 893	8 17	69 257	77 43	3 28	0 43	0 526
Barley	11 5	1 06	5 39	78 84	84 23	3 21	0 25	0 85
Oats	10 07	6 55	12 71	65 88	78 59	4 79	0 16	0 93
Maize	10 55	3 30	2 20	82 10	84 30	1 85	0 07	0 91
Gram	19 63	4 84	7 50	65 40	72 90	2 63	0 43	0 98

Balance studies on Nitrogen, Calcium and Phosphorus in the two groups were also made and the results are recorded in table II

TABLE II

NITROGEN, CALCIUM AND PHOSPHORUS BALANCES

	Group 1 Tamarind seed as entire concentrate Average of three animals	Group 2 Tamarind seeds supplying 50 per cent protein requirement Average of three animals
	ms	ms
Nitrogen (N) Balance	+ 1 213	+ 6 475
Calcium (CaO) Balance	− 1 176	+ 0 794
Phosphorus (P_2O_5) Balance	+ 1 277	+ 3 689

It will be observed that when tamarind seed constituted the entire source of digestible crude protein, the animals were in positive nitrogen and phosphorus balance, though they showed a slight negative calcium balance When, however, the tamarind seeds constituted 50 per cent of the required protein and the rest was made up with rape cake, all the animals showed positive balances for nitrogen, calcium and phosphorus

When this experiment was about to be concluded, morphological and chemical studies on the blood of these animals were conducted and it was found that there was no appreciable difference in the various blood constituents of the two groups of animals as compared to animals on normal diet

From the above observations, it appears that tamarind seeds can be fed to animals, with impunity, over long periods It is however profitable to feed these seeds up to 50 per cent of the concentrate mixture

According to an estimate by Krishna[9], 3,594,000 mds of tamarind seeds are available annually Although a fraction of it is understood to be used for sizing purposes, it is assumed that an economic use of the remainder will release the pressure on the existing acute shortage of concentrate feeds

Details of observations will be published in the *Indian Journal of Veterinary Science and Animal Husbandry*

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ON THE FLUIDITY OF LIQUIDS IN RELATION TO THE HOLE THEORY

Liquids are looked upon as containing free volume in the form of holes in which their molecules can move about with a limited degree of freedom[1] This free volume has been calculated in terms of temperature and total volume of the liquid[2] and the method for its experimental determination indicated[3] depending upon the velocity of sound in the liquid medium Flow of a liquid has been regarded as due to jumps of molecules from one such free space or hole into another by the action of some shearing stress In the light of this, fluidity has been considered as depending upon the availability of the number of such holes into which molecules may pass The empirical formula arrived at by Batschinski[4] has implicitly assumed a linear relationship between fluidity (ϕ) and the free volume $(V - V_s)$ in the equation

$$\phi = C\ (V - V_s) \qquad (i)$$

where V and V_s are the volumes of the liquid and the solid states respectively, the latter being regarded as possessing little or no holes and C is a constant

It is well known that the fluidity of a liquid increases with temperature Temperature also increases the volume of a liquid by what is commonly known as thermal expansion, which naturally increases the free *d* volume of the liquid because the volumes of molecules constituting the liquid does not suffer any significant *d* change with change in temperature unless the latter is of extraordinary magnitude Hence we may expect a relationship between ϕ and α, the coefficient of thermal expansion, as a matter of course Such a relationship is obtained as follows

$$\alpha = \frac{1}{V}\left(\frac{dV}{dT}\right)_p = \left(\frac{d\ \ln V}{dT}\right)_p \qquad (ii)$$

assuming α to be constant for small ranges of temperatures Integrating this we get,

$$V = A\, e^{\alpha T} \qquad (iii)$$

where A is the integration constant

Assuming that there is a temperature T_s in the absolute scale where the number of holes in the liquid vanishes altogether and carrying out the integration between T_s and any higher temperature T for which the volumes of the liquid are V_s and V respectively, we get

$$V = V_s\ e^{\alpha\,(T-T_s)} \qquad (iv)$$

whence by equation (i)

$$\phi = C\ (V - V_s) = C\, V_s\,\{e^{(T-T_s)} - 1\} \qquad (v)$$

$$\text{or, } e^{\alpha T_s} + \frac{e^{\alpha T_s}}{C\, V_s}\,\phi = e^{\alpha T}$$

$$\text{or, } \quad a + b\,\phi = e^{\alpha T} \qquad (vi)$$

where $a = e^{\alpha T_s}$ and $b = e^{\alpha T_s} / C\,V_s$

which gives a linear relationship for ϕ against $e^{\alpha T}$,

Equation (*vi*) has been verified in about 50 liquids including water and mercury within temperature range of 0 to 40°C in most of the cases with an average value of α in the range assumed to be constant. The plots obtained were all straight lines with an intercept on the $e^{\alpha t}{}_d$ axis ($= a = e^{\alpha T_s}$) as shown in Fig 1 from which the values of T_s were calculated These were in all cases lower than the corresponding melting points of the liquids except in the case of water where it was found to be above 4°C

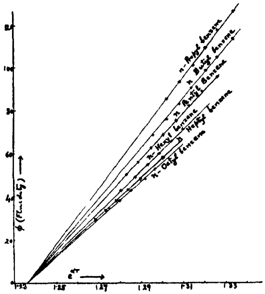

Fig 1

The volume V_s of the liquid at temperature T_s has been assumed to contain no holes and hence the molecular volumes of the liquids calculated for this temperature by the help of the average value of α, as assumed above, should necessarily yield the volume of a single molecule if we divide this by N, the Avogadro's number Calculations carried out in the case of some simple liquids (unassociated) are shown in Table I below

TABLE I

Liquid	r (calc in Å from Eq *vi*)	r * in Å
Mercury	1 778	1 80
Acetone	1 70	1 90
Benzene	3 098	2 95
Carbon tetrachloride	2 22	2 38 **
n Pentane	2 33	2 25
Ether	3 40	3 10
Chloroform	2 13	2 04

*r's denote the molecular radii calculated on the assumption of spherical molecules and r in column 3 signifies the radii calculated from the viscosity of these substances in the gaseous state and taken from Landolt Bornstein Tabiellen[6]

**The value of r for CCl_4 has been taken from polarisation data[6]

The chain lengths of some normal paraffins were also calculated from V_s by first ascertaining their molecular volumes and dividing this by 21 sq Å the cross section of these hydrocarbon chains as determined by the surface film method[7] The values appear in Table below and have been compared with those calculated by the formula given by Mark(9)

$l = (1\ 26n + 1\ 83)$ where n denotes the number of carbon atoms in the chain, and l the chain length

TABLE II*

Hydrocarbon	l (calc by eq (*vi*)	l (calc bu Mark's eq)
n-Pentane	7 6	8 13
n Hexane	8 98	9 39
n-Heptane	10 25	10 65
n-Octane	11 7	11 9
n-Nonane	12 8	13 17
n-Decane	14 08	14 43
n-Undecane	15 51	15 69
n-Dodecane	16 87	16 95
n-Tridecane	18 90	18 63
n-Tetradecane	19 62	19 47
n-Pentadecane	20 9	20 73

*Data on these hydrocarbons, necessary for our calculation, have been taken from selected values of Properties of Hydrocarbon's, [Amer Petrol Inst Res Proj no 44, Table 20(c), Part II]

The calculated values in both the tables exhibit satisfactory agreement with the values derived by other methods The equation (*vi*) therefore gives a method of computing the molecular dimensions from data on viscosity and density at two different temperatures

Another interesting feature in the $\phi - e^{\alpha T}$ plots is that the straight lines obtained for the members of the same homologous series have been found to intersect the $e^{\alpha T}$ axis at approximately the same point (Fig 1) Thus for the three different series studied in this connection the value of the intercept is 1 25, for the normal paraffins, 1 265, for the normal alkyl mercaptans and 1 235 for the benzene homologues This evidently indicates that αT_s for the same homologous series is almost constant within a very narrow range An attempt will be made to elucidate the full significance of this aspect in a future communication

The relationship between the coefficient of viscosity and temperature has been given by the classical equation of Andrade[8] as

$$\eta = A\, e^{B/T} \qquad (vii)$$

The equation (*vi*) can be related to this equation if we can show that the coefficient of expansion, α, of a liquid is directly proportional to $1/T^2$ Such a relationship has been deduced from statistical considerations through the partition function of the liquid state. The work is under way and will be reported later on in due course.

My best thanks are due to Prof S N Mukherjee, Professor of Physical Chemistry for kindly suggesting this problem to me and to Prof H L Roy, and the authorities of this Institution for rendering all facilities in their library and laboratory in connection with this work

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HEIGHT ADJUSTMENT OF MERCURY COLUMN FOR ACCURATE POLAROGRAPHIC MEASUREMENTS

The theoretical expression for the diffusion current obtained with a dropping mercury electrode derived first by Illkovic[1], is

$$i_a = 605n \ D^{\frac{1}{2}} \ C \ m^{\frac{2}{3}} \ t^{\frac{1}{6}} \qquad (1)$$

where i_a is the average current in microamperes (10^{-6} amp) during the life of a drop of mercury, n is the number of Faradays of electricity required per mole of the electrode reaction, D is the diffusion coefficient of the reducible or oxidisable substance in the units $Cm^2 \ sec^{-1}$, C is its concentration in millimoles per litre, m is the rate of flow of mercury from the dropping electrode capillary expressed in the units mg sec^{-1}, and t is the dropping time in seconds

For an ion in solution with a standard concentration of supporting electrolyte in a medium, D can be taken to be a constant Therefore i_a can be considered to be proportional to C, if and when $m^{2/3} \ t^{1/6}$ remains constant with change in applied *e m f* in the polarograph For practical purposes the product $m^{2/3} \ t^{1/6}$ may be assumed to be constant within $\pm 1\%$ over the potential range from zero to about -1 0 volt[2] but at more negative potential its decrease (which may be more than 10%) must be taken into account

It is shown below that the rule $i_a \propto c$ can be applied at all potentials if the height of the mercury column of the dropping electrode is adjusted in accordance with the final expression derived herein.

Mercury flowing out in drops at constant rate from the electrode exerts an appreciable back pressure against the hydrostatic pressure of the mercury column, thus diminishing the effective pressure forcing the liquid out of the capillary Kolthoff and Lingane[3] calculated the back pressure to be equal to 4 31 $\frac{\sigma \quad d^{1/3}}{m^{1/3} \ t^{1/3}}$ where σ is the interfacial tension of mercury and d is its density Applying this correction to the hydrostatic pressure and with the help of Poiseuille's hydro dynamical equation for flow of liquids through a tube they derived a theoretical expression for m *viz*

$$m = \frac{\pi r_c^4 \ d}{8\eta \ l}\left(h \ d \ g - 4\ 31 \ \frac{\sigma \ d^{1/3}}{m^{1/3} \ t^{1/3}}\right) \qquad (2)$$

The expression $\left(\text{hdg-4 31} \ \frac{\sigma \ d^{1/3}}{m^{1/3} \ t^{1/3}}\right)$ is the effective pressure P (say), where r_c and l are the radius and length respectively of the capillary, η is the viscosity coefficient of the liquid, h is the height of the mercury column

$$\text{It can also be written that } m = \frac{\omega}{t} \qquad (3)$$

where ω is the weight in milligrams of each drop of mercury

Combining equations (2) and (3) we have

$$t = \frac{8 \ \eta \ l}{\Lambda \ r_c^4 \ d} \ \frac{\omega}{P} = K \ \frac{\omega}{P} \text{ where } K = \frac{8 \ \eta \ l}{\Lambda \ r_c^4 \ d}$$

$$\text{and } m = \frac{P}{K}$$

$$m^{2/3} \ t^{1/6} = \omega^{1/6}\left(\frac{P}{K}\right)^{1/2} \qquad (4)$$

In the case of mercury at 25°C, $d = 13\ 53 \text{gm cm}^{-3}$
$\eta = 0\ 0152$ dyne sec cm^{-2}
$g = 981$ cm sec^{-2}

$\left(\frac{P}{K}\right)^{1/2}$ in equation (4) calculates to

$$\left\{4\ 64 \times 10^{9} \ \frac{r_c^4}{l}\left(h - \frac{7\ 73 \times 10^{-3} \ \sigma}{\omega^{1/3}}\right)\right\}^{\frac{1}{2}} \qquad (5)$$

When σ changes from σ_1 to σ_2 with change in e m f let ω change from ω_1 to ω_2 Let h be changed from h_1 to h_2 in order that $m^{2/3} t^{1/6}$ remains unchanged Then the following relation should hold

$$\omega_1^{1/6}\left(h_1 - 7\;73 \times 10^{-3}\,\frac{\sigma_1}{\omega_1^{1/3}}\right)^{\frac{1}{2}}$$

$$= \omega_2^{1/6}\left(h_2 - 7\;73 \times 10^{-3}\,\frac{\sigma_2}{\omega_2^{1/3}}\right)^{\frac{1}{2}} \qquad (6)$$

Squaring and transposing

$$h_1\,\omega_1^{1/3} - h_2\,\omega_2^{1/3} = 7\;73 \times 10^{-3}(\sigma_1 - \sigma_2)$$

$$\text{or, } h_1\,\omega_1^{1/3}\left(1 - \frac{h_2}{h_1}\,\frac{\omega_2^{1/3}}{\omega_1^{1/3}}\right) = 7\;73 \times 10^{-3}\sigma_1\left(1 - \frac{\sigma_2}{\sigma_1}\right)$$

$$\text{or, } \frac{h_2}{h_1}\left(\frac{\omega_2}{\omega_1}\right)^{1/3} = 1 - 7\;73 \times 10^{-3}\,\frac{\sigma_1}{h_1\omega_1^{1/3}}\left(1 - \frac{\sigma_2}{\sigma_1}\right)$$

$$\text{or, } h_2 = h_1\left(\frac{\omega_1}{\omega_2}\right)^{1/3} - 7\;73 \times 10^{-3}\,\frac{\sigma_1}{\omega_2^{1/3}}\left(1 - \frac{\omega_2}{\omega_1}\right) \qquad (7a)$$

$$\text{or, } h_2 = h_1\left(\frac{\sigma_1}{\sigma_2}\right)^{1/3} - 7\;73 \times 10^{-3}\,\frac{1}{\omega_2^{1/3}}(\sigma_1 - \sigma_2) \qquad (7b)$$

Taking σ_1 as the interfacial tension at a standard condition say when the mercury is not electrically polarised in 0, 1N KCl, equations (7a) or (7b) can be used to determine the heights h at which the mercury column should be at diffierent e m f s so that $m^{2/3}t^{1/6}$ remains constant As a fair approximation under ordinary conditions if σ_1 is taken to be equal to 400 dyne cm^{-1} in air free electrolyte solutions equation 7(a) can be written as

$$h_2 = h_1\left(\frac{\omega_1}{\omega_2}\right)^{1/3} - \frac{3\;1}{\omega_2^{1/3}}\left(1 - \frac{\omega_2}{\omega_1}\right) \qquad (8)$$

for a particular capillary ω_1 and ω_2 for various e m f 's can be determined experimentally by Lingane and Kolthoff's[2] arrangement

It has been pointed out that the height correction is of significance at more negative e m f 's where also the various electrocapillary curves coincide Thus ω_2 values determined in one case can be applied to other cases With capillary active substances ω_1 should be determined in individual cases.

My grateful thanks are due to Dr S K Mukherjee, of the department of Applied Chemistry for helpful criticism and kind interest

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GERMANIUM IN INDIAN COAL ASH

Goldschmidt and Peters[1] by spectrum analysis with the Cathode Layer Arc found germanium concentration in the order of about 0 1-1 0% in the coal ashes of the Hartley Yard Seam, Newcastle in England In our previous investigation[2], a thorough search for germanium in coal ashes from different coal fields of India was made and a fair concentration was detected in a few samples

In the present investigation, spectrographic estimation of germanium in coal ashes has been carried out by the Carbon Arc Cathode Layer method and also by the Logarithmic Wedge Sector method with a E_1 spectrograph Standard mixtures of germanium are prepared by adding standard solutions[3] of sodium germanate in dilute $H_2\,SO_4$, in pure quartz (free from germanium) In the cathode layer arc method, Twyman Simeon lens arrangement[4] with a slit length of 10 mm is used The cathode of purified carbon rod[5] has a crater of 8 mm depth and 2 5 mm inner diameter with a wall thickness of 0 8 mm in which a mixture of 10 mg standard mixture (or coal ash) and 10 mg pure carbon powder is introduced For each spectrum 120 seconds exposure is made using a current of 9 amps at 220 v d c The concentration of germanium in the samples is determined by visually observing the lines 3039 09Å and 2651 18Å under a comparator and matching them with the standard plates

In the Logarithmic Wedge Sector method, a slit length of 1 5 cm is used, the sector being uniformly rotated by an electric motor The anode has a crator of 10 mm depth and 2 5 mm inner diameter with a wall thickness of 0 8 mm in which a mixture of 20 mg standard mixture (or coal ash) and 10 mg pure carbon powder is introduced For each spectrum 120 seconds exposure is made using a current of 8 amps at 220 v d c The length of the spectrum line is considered to be a measure of the intensity A magnifier with a measuring scale is used to measure the lengths of the two germanium lines up to the point where the blackening just disappears A calibration curve is drawn with these

measured lengths of lines in the different standard spectra plotted as ordinates against concentrations of germanium Germanium concentrations in the different samples of coal ash are determined from the calibration curve Both the methods of analysis are very sensitive up to 0 001%, below which higher amounts of samples are required

TABLE

Specimens of coal ash	Ash p c at 400°c	Percent of Germanium
Assam		
1 Garo Hills 977(7)	2 10	0 122
2 Garo Hills 977(22)	1 63	0 095
Hyderabad (Dn)		
3 Birley Pit, Singareni Coal field No 1	7 14	0 065
No 2	7 21	0 055
4 Tandur	12 40	0 017

Coal ashes from these regions may be considered as one of the best tapping sources for the extraction of germanium in India where information for any other source richer than these has not yet been available

Thanks are due to Prof P B Sarkar, for his keen interest in the work and for providing laboratory facilities, and to the Director of the Geological Survey of India for kindly supplying the coal samples

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NEUTRALISATION CURVES OF ION EXCHANGERS

The neutralisation curve of Ion Exchangers containing only one type of active group in the hydrogen or hydroxyl form for Cation or Anion adsorption can be mathematically expressed by an equation of the type

$$a = c\,(1-y) + \frac{k_w}{x} + \frac{cyk_a}{k_a+x} - \frac{xc\,(1-y)}{\frac{cyk_a}{k_a+x} + \frac{k_w}{x}} - x$$

This equation has been deduced from considerations of Donnan membrane equilibrium and classical laws of electro chemistry where for Cation Exchangers

a = concentration of added base
c = initial concentration of active groups in the H form
y = fraction of the total active groups in solution phase
k_w = Ionic product of water
k_a = dissociation constant of the acid Ion Exchanger
x = hydrogen ion concentration

and for Anion Exchangers the terms have the same significance excepting the word 'acid' is to be replaced by 'base' and *vice versa* and 'x' denotes hydroxyl ion concentration

This equation has been found to apply in explaining large number of cases of titrations of Ion Exchangers containing one type of active group with HCl or NaOH for Anion or Cation Exchangers respectively The work of formulating equations for such titrations with bivalent acids and bases is now in progress The details of the work will be published elsewhere

My thanks are due to Dr S K Mukherjee for his encouragement and kind interest

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Calcutta 2 5 1949

ABNORMALITY IN *RANA TIGERINA* DAUD

Last January, while demonstrating to the Intermediate class in our college, I came across a full grown male frog (*Rana tigerina* Daud), 4 25 inches long from snout to vent, which showed an abnormality of a unique type, not hitherto described The specimen, when viewed from above, showed that the right side was normal with the eye ball bulging out, and the lids and the nictitating membrane properly developed, but on the left side the eye area formed a shallow depression with the outline of the orbit distinct and no trace of the eye ball superficially The left upper eye-lid, instead of being convexly arched in an even manner, was marked from the dorso median skin of the head by a groove at the upper border of the orbit, and was crumpled in appearance The lower eye lid passed on almost indistinctly into an opaque nictitating membrane, which extended smoothly upwards almost halfway into the orbit, formed a longitudinal plait-like ridge and was joined firmly with the upper eye lid There was no opening between the two lids

When, however, the mouth of the frog was opened the left eye ball was seen projecting into the buccal cavity and opening into it It was fully developed, had a normal appearance with the cornea, iris and pupil distinct, and faced obliquely rather outwards and

forwards towards the left (Fig 1) On its median and posterior sides, it was joined firmly by the

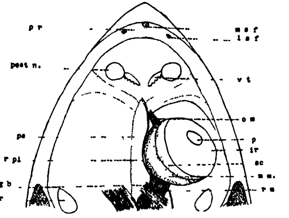

Fig 1 Buccal roof of the abnormal frog with some of the muscles dissected *in situ* (× 2)

e r, eustachian recess, i r, iris, lg b, ligamentous band, l s f, lateral sub rostral fossa, m m, mucous membrane, m s f, median sub rostral fossa, o m, oblique muscles, p r pulvinar rostrale, post n, posterior nerves, ps, parasphenoid, r m recti muscles, r pl, ramus palatinus, sc, sclerotic p, pupil, v t, vomerine teeth

sclerotic to the mucous membrane of the buccal roof covering the parasphenoid, but on its antero lateral side it was marked out from the adjacent area by a fairly deep depression in the connecting mem brane

On removing the temporal and the pterygoid muscles and dissecting away the mucous membrane of the roof of the mouth carefully (Figs 1 and 2), it

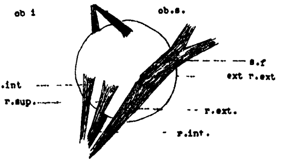

Fig 2 Dorsal view of the abnormal eye after dissection (× 3)

ext r ext, abnormal extension of the rectus externus, ob i, obliquus inferior, ob s, obliquus superior, r ext, rectus externus, r int, rectus internus, r inf, rectus inferior, r sup, rectus superior, s f, supernumerary fibres

was found that the *levator bulbi* was absent, but that all the obliqui and recti were present

The *recti* musculature was slightly twisted and showed a constriction almost midway between its origin and insertion Underneath it, there was a transverse ligamentous band which ran across from the postero lateral border of the stem of the parasphenoid bone to its lateral processes underlying the auditory capsules

The rectus inferior, *rectus superior* and *rectus internus* were normal in their disposition, but were shorter than those on the right side The *rectus externus*, although arising normally from the inner and posterior angle of the orbit close to the optic for a men, showed a remarkable anomaly in its insertion It was not inserted on the posterior surface of the eye ball as is usual, but rather on the dorsal surface Half of its fibres were inserted on the eye ball, while the remaining ones extended further on, beyond this point of insertion, to join the tough dermis underlying the malformed upper eye lid

In addition to this, there was another set of fibres which originated from the dermis of the upper eye-lid, ran obliquely backwards and inwards in the orbit, closely applied to the abnormally extended fibres of the *rectus externus*, and finally got inserted on the dor sal surface of the eye ball near the point of insertion of this muscle

The *obliqui muscles* resembled those of the right (normal) side except for the fact that the *obliquus superior* was slightly longer than the *obliquus inferior*

The *retractor bulbi* was found to be present in its normal position within the four *recti* and embracing the optic nerve As usual, it arose from the paras phenoid bone and was inserted into the eye ball

The nerves were normal except for a slight shifting in their position due to the deviation in the musculature The *ramus palatinus*, however, instead of running almost straight forward from the point of its emergence from the cranium, was a little curved in its course and extended over the ventro-mesial surface of the eye ball before dividing into its branches at the anterior end of the orbit

It is difficult to say whether the foregoing abnormality was congenital, or due to an accident which occurred during the course of development No bone was apparently affected in any way, while the superficial appearance of the eye lids seemed to suggest an injury which led to regeneration The supernumerary set of fibres described above in connection with the *rectus externus* was perhaps due to an extraordinary elongation of the dermal tissue underlying the eye-lid and to its fibrosis The structure of the eye, curiously enough, was perfect, but its position within the buccal cavity indicated that it could not have been functional as a visual organ

I am extremely grateful to Prof Beni Charan Mahendra for his kind assistance and direction in the preparation of the present note

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